A POPULAR ACCOUNT
OF THE
PROGRESS OF THE WORK
OF THE
MADRAS AGRICULTURAL DEPARTMENT
1922-35

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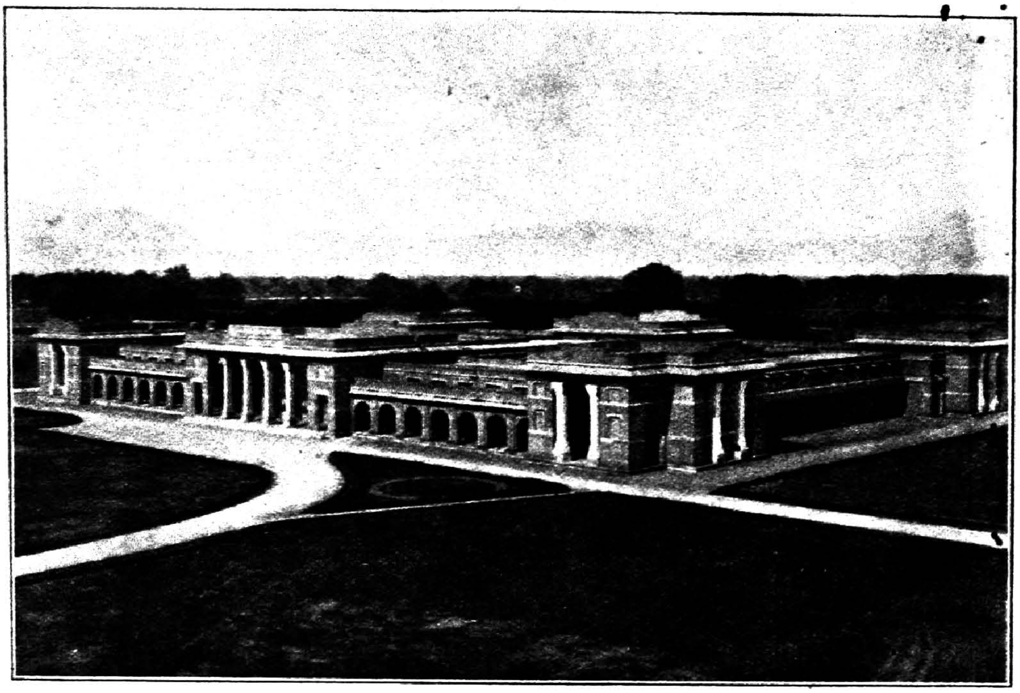

THE AGRICULTURAL COLLEGE—FREEMAN BUILDING.

Frontispiece.

DEPARTMENT OF AGRICULTURE, MADRAS

A POPULAR ACCOUNT

OF THE

PROGRESS OF THE WORK

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(1922–35)

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PREFACE

In July 1935, Government desired that the public mind should be educated in the various activities of Government since the introduction of the present constitution and suggested that Heads of Departments under the Development Department should prepare an account of the progress achieved in each Department. The Agricultural Department was fortunate in having a "Popular Account" of its work published in 1922. The present publication aims at bringing the book uptodate both in matter and presentation and includes information relating to a period of 13 years from 1922 to 1935.

As I write, I am conscious of two facts: that the old order is fast changing and will quickly give place to the new. The new constitution is soon to dawn. Secondly, in the activities of the Department things have moved so quickly during the last year or two that by the time the Account reaches the hands of the public it would almost cease to be uptodate in at least two sections, namely, live-stock improvement and demonstration.

The preparation of an Account of this kind, comprehensive and popular, depicting the various activities of the Department must have meant a good deal of work to every member of my staff. I avail myself of this opportunity to acknowledge the help so readily given. Equally difficult is the editing of such a publication but I was fortunate in having the whole-hearted assistance of M.R.Ry. Rao Bahadur G. N. Rangaswami Ayyangar Avargal, but for whose ready help it would not have been possible to bring it out in so short a time. The hard and persistent effort needed to collate the information in such a manner as to make it readable and interesting was at the sacrifice of the leisure of both Mr. Rangaswami Ayyangar and his staff to whom I owe my sincere thanks.

Madras,
18*th February* 1937.

D. Ananda Rao,
Director of Agriculture.

A POPULAR ACCOUNT

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CHAPTER I.

INTRODUCTION.

Agriculture under the Reforms.

1. A popular account of the work of the Madras Agricultural Department was published in 1922. This was done at the instance of the Hon'ble Rai Bahadur Sir K. Venkata Reddi Nayudu Garu, the first Minister for Development Departments who realized the need to give the public some estimate of the value of the work which has been and is being done by the Agricultural Department. This was necessary by way of educating the general taxpayer to a sympathetic attitude towards the provision of funds with which to develop nation-building activities of which agriculture is the most important.

Thirteen years have rolled by and in 1936 we are on the eve of further reforms in the Government of the country. On the threshold of the inauguration of these reforms, it is but appropriate that there should be a review of the achievements of the Agricultural Department during this period and the extent to which the Ministry for Development, developed it. The present account is a stern stock-taking of its achievements so that the public mind may be educated on the various developmental activities of the Department of Agriculture since the introduction of the present constitution. Agriculture is the most important avocation of the largest number of taxpayers in this country and it is but meet to consider the services rendered to that industry by the Ministers, as the measure of their response to the trust to which the reforms called them.

The Royal Commission on Agriculture and the Sugar Committee.

2. The outstanding event in the period under review is the appointment of the Royal Commission on Agriculture in India presided over by Lord Linlithgow now the Viceroy of India. The voluminous and thorough reports published by the Commission

embody recommendations of great import which serve as a pure guide to the orientation of all departmental activities along sound lines. The extent to which Madras has profited by and responded to these recommendations will be evident on a perusal of this popular account.

Another important event is the appointment of the Sugar Committee whose labours have resulted in that great landmark in the progress of industry and agriculture in India, namely, the granting of protection to the sugar industry.

The Depression.

3. The biggest drag on the unfettered development of the department was the general economic depression which affected practically every activity throughout the world. Retrenchments had to be effected and in the case of the Agricultural Department eight gazetted officers and twenty-four executive subordinates were axed. This is a serious cut in a developing department. This retrenchment was not without its educative value. It led to a consolidation of present activities and helped to draw up a cautious programme for the future so that a sound and steady scheme of development was made possible. Meanwhile the Imperial Council of Agricultural Research was inaugurated and its helping hand relieved in some measure the inhibitory effects of this depression.

Imperial Council of Agricultural Research.

4. The Royal Commission on Agriculture found that there was a wide field open for the co-operation of the Government of India and of Provincial Governments in regard to agricultural research and that it was the duty of the Government of India in the discharge of their ultimate responsibility for the welfare of the vast agricultural population of this country to advance research in every possible way without encroaching upon the functions of the Provincial Governments in that sphere. The plan conceived to meet this need was the constitution of a body on which the Provinces will be represented and which will be endowed with funds that could be allocated for the development of research. This Council was constituted and the representatives of Madras have collaborated with it in the fullest measure and have made substantial contributions to the deliberations of this central council. Nine schemes of research most of them spread over a period of five years each are under way. The total cost of the schemes is nearly seven lakhs of rupees. They cover a wide field and include research programmes on fruits, potato, rice, sugarcane, dry-farming, animal nutrition, malt making, marketing and cost of production of crops. Eight gazetted officers and twenty-one assistants work under the scheme. In addition to this, five schemes costing over two lakhs of rupees have been sanctioned and await the provision of funds. When these schemes begin to operate oil-seeds (including coconuts), bananas, sunnhemp fibre and sheep will receive special attention.

The Indian Central Cotton Committee.

5. Relief also came from the Indian Central Cotton Committee which was constituted by the Government of India in March 1921 and which is financed by the Cotton Cess Act of 1923. The chief object of this Committee is to stimulate and assist in every possible way the production, marketing, and utilization of Indian cotton. One of its functions is to finance local Governments on research work in the problems connected with the improvement of Indian cotton on a comprehensive scale. The Madras Department of Agriculture has not been slow in availing of the opportunities and facilities afforded by this body. Four schemes financed to the extent of nearly four lakhs of rupees are being undertaken. These schemes employ the following research workers: a Bio-Chemist, a Crop Botanist, a Physiological Botanist, a Parasitologist, and eleven scientific assistants, thus securing a substantial augmentation in both men and money to supplement the endeavours of the local Government. The origin and objects of the four schemes are detailed in the section on cotton.

Increase in Personnel.

6. In spite of the retrenchment, the personnel of the department has increased in gazetted ranks by about twenty-five per cent and in the ranks of the non-gazetted executive staff the number is nearing double. This increase in personnel is very important. In the past additions to staff (the human agency in development) suffered from the difficulty of securing properly trained men to tackle technical subjects. If there has to be sound development, the department has to be manned by a trained staff. The training of students in the agricultural college is comprehensive and costly and it is a matter of satisfaction that the department has been able to secure the services of such a trained staff.

Indianization.

7. The Indianization of the department has gone on steadily. The general principle of the employment of specialists on short term contracts pending the training of suitable Indians to take their place was given effect to in the case of rice. An officer of the department was sent on deputation for two years for the purpose of undergoing a course for the Diploma in Agriculture specializing in plant genetics. He has returned and taken the place of the Paddy Specialist permanently.

University Course in Agriculture.

8. The creation of a separate Faculty for and the institution of a B.Sc. degree course in Agriculture by the Madras University are landmarks in the history of agricultural education in this presidency. The foundation stone for a separate block of buildings for accommodating the college was laid by Lord Willingdon, the

then Governor of Madras, in June 1922. This was called, "Freeman Building" after His Excellency. This building was opened in 1926 by Lord Goschen. Want of accommodation was, in former years, a constant handicap to the extension of agricultural education and the provision of this new college building meets a much needed want. Whereas in the past 20 students were taken in each year, the present admissions have come up to over 40. The economic depression led to the stopping of free admission to the college and from the year 1931–32 a fee of Rs. 120 a year was levied. This fee not withstanding, the course is fairly popular. The necessity for a close co-operation between the agricultural and co-operative departments has been well recognized and to ensure the requisite training to fit the agricultural graduates for a co-operative career, a course of instruction in co-operation, auditing, book-keeping, and banking has been recently provided.

Short Courses in Practical Agriculture.

9. The intensification of higher agricultural training to the standard demanded by the University necessitated the abolition of the short two-year course in agriculture. The training given in agriculture should either be very scientific or be eminently practical. To meet this latter demand a short course in practical agriculture was instituted at the college for the benefit of young men who cannot undergo the university course. No fee is charged for tuition. The courses provide for training in Farm Management, Dairying, Care of Animals, Insect Pests and Diseases, Malt making, Manures, Crop Improvement, Jaggery-making, Bee-keeping, Horticulture and Vegetable gardening, and extend from one month to ten months according to the subject.

Agricultural Middle Schools.

10. The institution of a higher university course and the short practical courses raised the question of the continuance of the old agricultural middle schools. The depression added to the serious consideration of their future. It was obvious that these schools failed to fulfil their expectations namely to raise up a class of cultivators who shall be better cultivators than their fathers, more alive to the possibilities of their traditional occupation and more receptive to new ideas. Agricultural education as such has failed to appeal to the children of cultivators. The end being sound, it was felt that possibly this vernacular agricultural education was in advance of public opinion, but unless given a fair and sincere trial will not educate public opinion. The situation was thus working in a vicious circle. There was the fear of a premature giving up of this commendable endeavour. There was also the risk of continuing a costly experiment during a period demanding retrenchment in all possible directions. The Anakapalle agricultural middle school which was opened in 1922 was closed down in 1928. The Taliparamba middle school, started along with Anakapalle was closed

in 1932. This was the experience gained in these experiments in the Circars and in the West Coast. There is at present a school for *Kallars,* a tribe of backward classes in the Madura district, for whose benefit the District Board of Madura is running an institution at Usilampatti. The Government gives a half grant and loans the services of trained staff. Catering as this school does to a definite backward community, the training is broad based in its goal and as such this new experiment looks promising and its future is watched with interest. The concern of the local board in the agricultural advance of a backward community in its area is a guarantee to the success of the endeavour.

General Educational Activities.

11. In addition to the short courses on the specific subjects the Department of Agriculture never missed any opportunity for furthering the general cultural advance of the agriculturist. Advantage was taken of *Jamabandi* to give a popular lecture or two. Schools for juvenile and adult labourers are being run at Coimbatore, Palur and Anakapalle. Some elementary school teachers from Vizagapatam and Godavari were trained at the Anakapalle and Samalkota Agricultural Research Stations. A draft syllabus for Government Technical Examinations in Agriculture, Higher Grade, was drawn up by the Professor of Agriculture. These small and varied bits of activities are a few among the many contacts established by the Agricultural Department with the general educational progress of the rural community.

Research—Fundamental and Regional.

12. The research work carried on by the department is the most important of all its activities. On the results obtained by this work are founded the instruction imparted at the Agricultural College and other institutions and the demonstration work conducted in the districts. It is in fact the foundation on which the whole fabric of the department rests. The primary purpose of all the research work is the acquisition of exact knowledge. The ultimate purpose is the translation of this exact information into a definite recommendation which the cultivator can adopt as part of his ordinary farming practice and which if adopted will result directly or indirectly in a higher return from the land. However much the actual research work may appear to be divorced from practical farming this ultimate object is always held in view. The chief centre of research is the Institute at Coimbatore equipped with a staff of specialists. Here, plant breeders endeavour to evolve new strains in paddy, cotton, millets, oil-seeds and other crops; pathological problems affecting crops are investigated by the Entomologist and the Mycologist; the Chemist is engaged in matters dealing with the nutrition of plants and animals or with conservation of moisture, and the Research Engineer is concerned with the improvement of the various indigenous implements, bearing in mind the needs and

limitations of the ryot. In intimate association with these officers are those in the districts—the Deputy Directors of Agriculture—who in their agricultural research stations have two-fold functions to perform, viz., the putting to test on a field scale the discoveries made at Coimbatore in places which are dissimilar in soil and climate and in the investigation of the various local problems in farming practices which await solution. Therefore the two sets of officers—those at Coimbatore and in the districts—work in collaboration with the one object of gaining knowledge which would ultimately result in benefiting the cultivator. There are twenty-six Agricultural Research Stations in the Presidency, some of them for studying general farming problems, and some, for specialization in livestock, fruits, coconuts, pepper and potatoes and such other special lines.

Agricultural Chemistry.

13. The Chemistry section is the largest at the Agricultural Research Institute. Its routine work is mainly analytical. For a nominal sum ryots can have their soils and manures analysed and obtain valuable advice. Research is however the predominant activity in the section. A quarter century of experimental work with indigenous manures and artificial fertilizers was reviewed by a special officer at the instance of the Imperial Council of Agricultural Research. The outstanding conclusions of this enquiry are that the most useful and successful manures are green manures with and without phosphates for the paddy crop, oil-cakes for sugarcane and farm yard manure for all garden and dry land crops, and that artificial fertilizers are only of secondary importance in our agriculture. In combination with organic manures, the artificial nitrogenous fertilizers were at their best in their performance while the reverse was generally the case when used alone. An analytical study of the nature of action of the fertilizers when applied alone revealed a tendency to bring about adverse changes in soil conditions and consequent decline in yields. Among phosphatic manures, superphosphate and bonemeal proved themselves to be really useful both in their immediate and residual effects. When combined with organic manures or artificial nitrogenous fertilizers, superphosphate was more efficient than bonemeal but when used alone super often showed itself unreliable. In almost all cases tried there is no crop response to applications of potash to the soil.

In addition to the old soil surveys, the district of Malabar has also been surveyed, as also the Periyar tract of the Madura district. Information of the present fertility status of these soils is available to serve as a reliable guide in the prescription of the nature of manure to be applied to the lands of these tracts. Soil survey work has tended from being regional, to be confined to specific problems like the probable response of soils of tracts in which irrigation schemes are projected. It has been the experience in other parts of India and of the world that when an irrigation project has been undertaken without a previous survey of the probable response and

possible repercussions of the application of irrigation water to lands unaccustomed to receive any other than rain water, the result has in some cases been disastrous to the lands sought to be profited, raising more problems for solution than the original one sought to be solved. A preliminary survey would thus seem to be the first rational step to be taken before launching costly irrigation schemes. With this background of far-seeing economics, a survey has been made of the area proposed to be irrigated under the Lower Bhavani Project. A similar survey has just been completed of the area under the proposed Tungabhadra Project, and the indications are that the note of pessimism sounded in certain quarters against these schemes has been unduly gloomy and that there need be no fear of deleterious effects with a judicious use of the water to be made available.

Not all areas even if irrigable could be irrigated. Rain and rain-water continue to be the final arbiters in the destinies of millions of poor cultivators and their dry lands. Such lands are cheap and are the only ones that the poor and the lowly could own. The question of the nature of soil-physics that operates in the holding of the moisture that is available in the soil after the precipitation, through judicious cultural and other treatments, presents a problem of the first magnitude to the lasting benefit of the dry land farmer. It is therefore none too soon that a Soil Specialist wholly devoted to this important problem of physical chemistry has been appointed. He is at present stationed at Hagari in the Bellary district and is closely collaborating in the Dry Farming Scheme.

To know the chemical composition of the soil and its physical properties is not enough. Every animal and plant owes its existence to the fertility of the soil, and this in turn depends upon the activity of the bacteria which inhabit the soil in inconceivable numbers. We are familiar with bacteria and the first association that comes into the mind when we think of these organisms is the havoc they play on human life. How they permeate the whole of our existence —in the air, in water, in the soil and in our food—is a matter which is not easily recognized till we are up against some malefic aspect of their presence. That they can be beneficient will be obvious to any one familiar with the health giving bacteria in buttermilk. A study of these bacteria in their manifold relation to agriculture is thus of paramount importance and an Agricultural Bacteriologist is devoting his attention to this subject.

The intensive study of human nutrition is receiving the attention of other institutions interested in public health and is financed from funds available for the purpose. The problem of animal nutrition is of very great importance, especially when we realize the necessity of conducting researches under Indian conditions with Indian animals. It has been found that a blind application of western standards is uneconomic. In an agricultural country where the human population is itself in need of a full supply of food, it is wasteful to feed animals without a knowledge of their requirements. The general tendency in animal husbandry is to advocate the keeping of fewer animals and a more rational feed for them. From this

point of view the addition of a wing devoted solely to animal nutrition is a development of much potentiality. The chemical section with its manifold equipment is thus in a position to take a comprehensive view of its functions and thus serve the Indian cultivator with knowledge.

Plant Pathology.

14. Of the disturbances that a cultivator experiences in the pursuit of his avocation, nothing is so chilling as his impact with insect pests and fungoid diseases. These have to be controlled and their spread checked. This can be done only with a knowledge of their life history and their relationship to their host plants. The sections of Mycology and Entomology deal with these pests.

The Mycological section handles fungus diseases which are of vegetable origin. The first essential in investigating such diseases is to grow the fungus on a suitable medium in order to ascertain how it lives and spreads and also to be able to identify it by the spores which it forms. In many cases, such a fungus has a definite resting state by which the disease is carried over from one season to the next and thus infection is continued. It is also necessary to ascertain which particular part of the plant is attacked and how the fungus gains entrance into its host. All these mean detailed microscopic work in the laboratory. The next step in dealing with the disease is to try different methods which are suggested by a study of the life history for keeping it in check, or for destroying it, and much work of great value to agriculture has already been achieved. The bud-rot of palmyra, the *mahali* of arecanut, the blast on paddy, the red-rot of sugarcane, smuts on millets, and the mildew on grape-vine are familiar examples of these diseases. Various remedial measures have been advocated and are in general practice.

The Entomological section deals with insect pests. Of the most recent advances in the control of these pests is the biological method of control. This method proceeds on the principle that there is a balance in nature by which there is mutual destruction keeping up a balance in the population, so that banking on the fact that there are insect enemies to insects, the Entomologist sets as it were "a thief to catch a thief." Of the successful instances of utilizing this weapon may be mentioned the achievement on the control of the insect pest on the wattle in the Nilgiris, and the check to the coconut leaf caterpillar in the West Coast. It is not only that destructive insects are fought against, but the Entomologist also harnesses useful insects to the service of the cultivator. In apiculture and in sericulture much practical experience has been gained and made available to the cultivator and thus the cause of two valuable cottage industries has been served.

When pests break out in an epidemic form, the best step is to delimit the areas of their devastation, and with this end in view, the pathologists take a hand in Legislative measures which though

inconvenient and unpopular to begin with are ultimately fruitful of abiding good. A notable advance in the period under review is the decentralization of relief measures in the control of insect pests and fungoid diseases. Formerly assistance used to be sent from Coimbatore on receipt of intimation from cultivators in distress. This was often dilatory and in-effective. Consequent on this experience it was felt necessary to station technically trained staff in different centres of the presidency so that efficient help is handy. Assistants trained in Plant Pathology are now at the service of the cultivator and ready to respond to his calls at Samalkota, Guntur, Bellary, St. Thomas Mount, Aduturai, Kovilpatti, Palghat and Taliparamba.

Specialization in crops.

15. The need for specialization in crops is becoming more and more felt and with the growth of interest in agriculture more crops are getting to be known intensively about. The monograms on wheat by Percival, cotton by Balls, rice by Copeland, Oats by Etheridge and maize by Weatherwax are notable examples. In India cotton was the first crop to be studied intensively. Wheat, sugarcane and rice came next. The starting of work on millets has coincided appropriately enough with the coming into administrative prominence of that desire to do justice—and, equally, justice to the food crops of the poor. In the period under review along with millets, specialization was undertaken on oil-seeds including coconuts, on sugarcane for Madras conditions on fruits, potatoes and bananas. In rice, regional activities intensified in the opening of sub-stations at Aduturai in the Tanjore district, Maruteru in the West Godavari district, Patambi in Malabar, and Berhampur in the Ganjam disdistrict. Assistants trained in cotton and millets reinforced the staff at the Agricultural Research Stations, Hagari, Nandyal, Guntur and Kovilpatti.

Paddy.

16. Of all the improvements effected by the department, the most outstanding is the spread of improved varieties of paddy. There may at present be a slump in the paddy market but when we realize that most of the population of this presidency consume rice and that our production is insufficient and necessitates importation, it will be easily conceded that every endeavour at producing more has a direct bearing on our primary food supply. The paddy strains evolved are many and of these G.E.B. 24 may be singled out for special mention. This strain has swept over the presidency and has captured Mysore as well. The introduction of new strains has resulted in the practical disappearance of red rice which used to be a chronic mixture in white rice varieties. There is a greater uniformity in the size of the grain produced and thus better milling qualities. Twelve years ago, the acreage under improved strains was only a quarter of a lakh. The present area stands well over

9½ lakhs of acres—a progress nearly forty fold. Another improvement long advocated is the economic transplantation of paddy seedlings. This economy results not only in a saving of seed but also in the added vigour and better yield of the fewer seedlings having a freer growth. The area under this improvement is coming to a stage when it is difficult to keep track of its progress. There were nearly 6 lakhs acres under this improvement and the present figure is 10 lakhs. The estimated gain by this improvement at Rs. 3 per acre is 30 lakhs of rupees per annum. The introduction of green manures is an improvement to which the department can take sole credit to itself. Its progress is noticeable all over the presidency. The total area under green manures in 1922 was about 50,000 acres. The present area is nearly two million acres. The gain to the cultivator by growing green manure crops will vary according to the tract; even so, at a cautious estimate of Rs. 5 per acre this improvement by itself could be evaluated at about nine lakhs of rupees. The knowledge that there are many other manures besides those produced on the farmer's holdings themselves was for a long time restricted to a limited few. It has been found that the application of bonemeal and Trichinopoly phosphate in conjunction with green leaf is an effective method of manuring paddy lands. Consequent on the propaganda carried on by the department bringing home this knowledge to the cultivators the area manured with artificial manures through departmental agency in the Trichinopoly Circle has been showing a steady increase from 1,000 acres in 1922 to nearly 48,000 acres in 1934. The gain to the cultivators by such applications is estimated at Rs. 5 per acre and comes to Rs. 2,40,000.

Cotton.

17. Cotton is the industrial crop on which considerable amount of work has been done in the past and in which fresh progress could be reported. The value of cotton research has considerably increased now that the Indian mill industry is growing very rapidly. The improvements fall under two groups, (1) improved strains of local varieties, and (2) the spread of Cambodia cotton and the introduction of improved strains of the same cotton.

Cambodia cotton has been introduced into the Guntur circle. There is a good future for this cotton in the fertile dry lands of Guntur which receive a fair amount of rain. In the Trichinopoly, Madura and Coimbatore circles where Cambodia was already introduced and was thriving, improved strains of Cambodia cotton have spread over a lakh of acres which at a gain of Rs. 15 per acre means an added income to the cotton grower of 15 lakhs of rupees.

Nearly 17,000 acres are occupied by the *Karunganni* introduced in the Coimbatore district. At a gain of Rs. 5 this introduction results in a profit of Rs. 85,000. In the Bellary area the strain H-1 occupies an area of 230,000 acres. At a profit of Rs. 2½ an acre

this improved cotton adds to the cultivator an income of Rs. 5,75,000. Similarly in the Tinnevelly tract $1\frac{1}{4}$ lakhs of acres are under improved strains and yield easily a gain of 5 lakhs of rupees. In addition to this direct gain through the crop the additional gain through improved cultural operations made possible by the spread of the drill sowing of cotton over 12,000 acres in the Madura circle alone works to a gain of nearly Rs. 50,000.

Sugarcane.

18. Sugarcane is what may be called a rich crop, rich in its return of income and needing the resources of a fairly well-to-do cultivator for the necessary initial outlay. There are one lakh of acres under sugarcane in this presidency. The general shyness to invest capital in the growth of this crop has been very largely overcome consequent on the protection afforded by the Government of India to the Sugar Industry and the stimulus that has consequently been given to the opening of sugar factories for the local production of sugar. Apart from sugar, jaggery is a commodity for which there is a steady demand. These two factors and above all the availability of a large number of cane varieties suited to varying conditions evolved by the Sugarcane Expert have helped in the increase of the area under cane. This has brought about a helpful response on the part of the cultivator to come to the aid of a budding industry. What is most noteworthy is the replacement of old uneconomic varieties by healthy and robust ones. This replacement commenced years ago when the declining Red Mauritius variety had to be replaced. The phenomenal spread of the cane, Co. 213, is a noticeable achievement. Since then the old canes have been replaced by new ones in an area of nearly 50,000 acres. These introductions have been new items in the propaganda work of the Guntur, Trichinopoly, and West Coast circles. The estimate of increased gain through the introduction of these improved canes varies from circle to circle but could be safely averaged at Rs. 30 per acre. These new canes have therefore meant a gain of 15 lakhs of rupees to the sugarcane grower of the presidency. When more factories have been built, the area under cane will increase very rapidly and in anticipation thereof a special officer is in charge of a scheme of sugarcane improvement for the benefit of this presidency, financed by the Imperial Council of Agricultural Research. In addition to the introduction of superior varieties, two other improvements are the introduction of iron mills and of improved furnaces with boiling pans. These improvements had already made a substantial progress some years ago. Being long-lasting deadstock they are not quickly replaced. Nevertheless the introduction of better varieties and the general toning up given to the sugar industry have resulted in the introduction of mills which crush canes from an area of 3,650 acres in the West Coast. This has resulted in a gain of Rs. 20 per acre, the total gain being Rs. 73,000. Pans have now been introduced in an area of 16,700 acres which at a calculated saving of Rs. 10 per acre leads to the gain of Rs. 167,000.

Fodders.

19. The solution of the fodder problem is the key to the solution of the wider problem of bringing about a general improvement in ordinary farming practice. A partial solution of this problem would be achieved if it were more generally realized that the quantity of cattle-manure produced on a given holding is more a function of the amount of fodder fed and of litter used than of the number of cattle owned. This would lead to the gradual elimination of the unnecessary cattle now being kept and would ease the situation for the necessary cattle. This is not all. It is still necessary to increase the yield of fodder to provide a sufficiency of feed for the cattle which must be kept and to supply more litter in order to increase the amount of cattle-manure for which there is such dire need. Among annual fodder crops *cholam* is the most common. *Cumbu* and sunnhemp come next. *Teosinte* (allied to maize) has been found to grow well at Hosur. A mixture of *Teosinte* and *Pillipesara* has proved a good fodder at Aduthurai. Of perennials the indigenous *Kolakattai* grass has been widely introduced. Among exotics, guinea grass, elephant grass and lucerne have been popularized. The assistant in Systematic Botany at Coimbatore has raised many fodder grasses in small plots for observation and study for their yield, adaptability and palatability. Digestibility trials on grasses are under progress. The free cutting of hill grass by local cultivators in certain forest areas has been permitted by the Forest Department. To afford facilities and encourage the cultivators in the growth of fodder crops as such, the Government charge no water-rates on them subject to certain conditions. This valuable concession has been widely made known through leaflets. In Malabar where the concentrated rainfall makes for a lavish vegetation in a part of the year only, steps have been taken to convert the excess grass into silage and thus tide over the long spell of dry weather from January to May when cattle have little or nothing to eat. *Ragi* straw hitherto considered an indifferent fodder has been successfully converted into valuable silage.

Medicinal and other Plants.

20. The question of meeting the demands of the Indian Medical Stores for drugs by growing them locally has been receiving attention. Many drugs are being tried in the hills and in the plains. Of these trials, successful results have been obtained in the growth of Jalap, Ipecacuanha and Foxglove in the Nilgiris, of Senna in Tinnevelly and of Sweet Flag at Palur.

Agricultural Engineering.

21. A census of agricultural machinery and implements is taken once in five years. The last census was in 1935. In that year there were in this presidency 4,337,000 wooden ploughs, 43,000 iron ploughs, 1,194,000 carts, 26,000 sugarcane crushers, 3,700 oil-engines, and 900 electric pumps. These figures show the extent

to which the agriculture is dependent on mechanical equipment. Some element of engineering is involved in nearly every agricultural operation. Consider the raising of any crop. The ploughing, pulverizing and levelling of the soil, the cleaning and grading of seed and its drilling, the irrigating, inter-cultivating, and weeding, the harvesting, thrashing and hauling of the crop to the market are all operations to which the skill of the engineer may be applied to enhance efficiency. The need for research into this specialized branch of engineering is, therefore, of paramount importance. It is obvious that manual labour alone can never cope with agronomic needs. Some implement or other has to be used by the farmer in every one of his operations. The more efficient his mechanical equipment the better is the return. That research tells in this line will be evident from two recent investigations. An 8 per cent increase in efficiency has been obtained by the use of " roll easy " *mhote* wheels. In tests with plough share points, a 50 per cent increase in efficiency in wearing quality has been secured by the use of steel with a heavy chill on both sides against one with a medium chill. As the price in both cases is the same the former is obviously the cheaper article. It is, therefore, none too soon that a whole time Agricultural Research Engineer was appointed to the staff of the Agricultural Department in 1928. A properly equipped workshop was provided for him in 1930. What is assured now is an intense agronomic bias to this research. In this connexion, mention has to be made of the most efficient harrow which goes by the familiar name of H.M. (Hilson-Munro) *Guntaka*, an implement which we owe to the keenness of two of our agricultural officers. A bund former designed by the Research Engineer is a recent useful addition to our stock of simple implements, and more improvements of a similar nature can be looked forward to in the near future. An important consideration in these improvements is to keep in the forefront the hard fact that the average Indian cultivator is not able to go in for costly implements. What is needed is to work up to an efficiency and work down to a minimum cost. Another consideration is that of giving an impetus to the local production of these implements and thus aid local industry.

Electricity and Agriculture.

22. The intensive activities in the development of hydro-electric schemes and the consequent availability of cheap power bring into prominence the role of electricity in agricultural development. The Government have already begun to supply power from the Pykara scheme to Coimbatore, Pollachi, Tiruppur, and other places. For agricultural purposes power is supplied at the low rate of one-anna per unit with every likelihood of a reduction in the near future. At the Central Farm, Coimbatore, all the old oil-engines have been replaced by electric motors and valuable experience and data are being obtained in their use for agricultural purposes. It is hoped to utilize this power on a wider scale in practically every field of agronomic activity.

Livestock.

23. The improvement of cattle is of vital importance to Indian agriculture and should go hand in hand with improvement along other lines. Cattle are the backbone of the cultivator. The two wings of the Imperial Council of Agricultural Research, one for Agriculture and another for Animal Husbandry connote their equal importance. Sound policies have to be laid down and steadily pursued in this vital work. The human population of this presidency in 1931 was 47 millions. In the livestock census of 1930, there were recorded 16½ million oxen, 13 million sheep, 7½ million goats, and 6 million buffaloes. In addition to these there are innumerable pigs, geese, poultry, and turkeys and the total population of these livestock so necessary for the well being of the cultivator, will mount up to very many millions. Their health is necessary for his health and their prosperity reacts on his. It is, therefore, quite appropriate that the Departments of Agriculture are having their Livestock Experts. When the Army Remount Depot at Hosur was closed down, the extensive areas and buildings belonging to that depot were taken over by the Agricultural Department in 1924. The Hosur Cattle Farm now affords the much needed central research station for the improvement of livestock. The Deputy Director of Agriculture for Livestock has his headquarters at Hosur. The research station there is in charge of a gazetted Superintendent. Work on the improvement of the *Scinde* and *Kangayam* cattle is the main item in the programme. The *Hallikar* breed is receiving some attention. Intensive work is in progress on the various breeds of poultry. Pigs are receiving their due share of care. This central station and its present development into the position of one of the premier livestock research stations in India is one of the notable achievements in the agricultural development of the province during the last decade.

Another development was the starting of a breeding station for buffalœs at Guntur. This station had to be clipped down in its activity, consequent on retrenchment. The severest blow that retrenchment dealt was on the Cattle-Breeding Station at Chintaladevi where work on the improvement of the famous Ongole breed of cattle was in progress. The Chintaladevi farm had the serious disadvantage of coming into existence in an inaccessible interior of the Ongole tract, and the decision to close it down was reached the easier due to this serious handicap. A select herd of these *Ongoles* along with a select herd of buffalœs (at present) form part of the Agricultural Research Station at Guntur. The work on the *Ongoles* and on the buffaloes are of such permanent importance that the earliest opportunity is to be availed of for setting up two separate fully equipped stations which will form centres of research in the breeding of these animals.

Livestock research is a slow process. We cannot alter the course of nature and cause the animals to be much more prolific or cut down the interval which must elapse between one generation and the next.

It takes seven or eight years to establish a pure strain of a cereal crop where self-fertilization is possible, where a generation can be obtained once a year and where the progeny of the first generation numbers hundreds and that of the second and subsequent generations can be numbered in thousands. It must, therefore, of necessity take very much longer to establish a good strain of cattle when the cow does not always give one calf once a year and when it takes three years at least before that calf in turn reproduces itself. It is a common experience for one to be able to trace the well formed features of the village *Brahmini* bull in the progeny of the village herd. The present system by which bulls of doubtful and unknown pedigree are allowed to leave their dubious imprint on the village herd is very defective and should if persisted in, prove disastrous to our cattle wealth. Pending the full supply of bulls reared by the department, a system of giving premia for good bulls maintained by private individuals is in some small measure lending its helpful hand. Bulls maintained by Municipalities, District Boards, and Co-operative organizations are an additional source of strength. Feeble as these endeavours are they are nevertheless of great significance.

Whereas cattle are within the orbit of the middle-class agriculturists, poultry are within the reach of the humblest individual. In recent years, there has come about an amazing keenness in poultry-keeping, so much so, that even to a casual observer the many white Leghorns that greet his eye in the villages are symptomatic of the sure and steady way that a good improvement finds its progress in the right quarters. Attached to many of the agricultural research stations are some breeds of improved poultry and the demand for eggs and chickens for rearing purposes is beyond what can be met with.

Betelvine Diseases—an instance of collaborative research.

24. Whereas each expert is a specialist in his own line, the collaboration of the experts among themselves and with the officers in the districts is very essential in the solution of an agronomic problem. There are many instances of such collaboration and one of these is given here. The betelvine gardens at Vellalur and other villages along the Noyil river in the Coimbatore district were subject to diseases as a consequence of which the vines became stunted in growth and put forth very few branches and leaves. The leaves were undersized and poor in quality. The local belief is that the diseased condition of the crop is due to the prevalence of earthworms, which tunnel into the soil at the base of the vines and thus reduce it to a sponge-like meshwork, interfering thereby with the free development of the root system. The ryots further believe that the worms directly feed on the cattle manure and other organic manures applied to the crop and deprive the betelvine of its legitimate source of nutrition. A preliminary examination revealed in

addition to the earthworms minute eel worms on the roots and fungus on the leaves. A joint investigation of this problem was carried out by the Agricultural Chemist, the Mycologist, the Entomologist, and the Deputy Director at a temporary station at Vellalur. The investigation revealed that defective soil conditions are the factors chiefly responsible for the poor growth of the vines and that adequate drainage of the fields resulted in marked improvement. Removal of excess water and raised beds have afforded considerable relief. The application of lime resulted in a great improvement in the yield of the plants. The lime improved the soil texture and acted as a disinfectant against pathogenic organisms in the soil. From the entomological investigations it was found that the presence of a large number of earthworms is more an index of the unhealthy soil conditions than an actual causative factor in the decrease of the output of the crop. When the water-logged condition was remedied, the worm population decreased automatically. The Mycologist reached the conclusion that the deterioration of the vines is not directly attributable to any definite pathogenic fungus but many weak parasites invariably invade the betelvine plants when in a lowered condition of vitality and hasten the decay and death of the plants. The solution of this problem affords an excellent example of the team work of the various experts of the department in the investigation of a single agricultural problem. While the problem was investigated by each expert from his own point of view the experts collated their results at every stage until causes and effects were analysed and suitable remedies suggested.

Demonstration.

25. Research discovers improvements in the local methods of agriculture. When this has been done, and after suggested improvements have been thoroughly tested out on the experiment stations and found to be applicable to local conditions, the next step is to teach the improvements to the ryots. This is done by the district staff of Deputy and Assistant Directors and Demonstrators. It is not at all an easy thing to teach the ryots a new method and persuade them to adopt it. It is no good simply to go about and tell them about it, and advise them to try it. The ryot, like farmers all the world over, is cautious and quite rightly wants to be convinced of the reliability of anything new before he adopts it and changes his ways. The experiment stations by themselves do not impress him. In the first place, they are *experiment* stations and not demonstrational farms, and in the next place, the ryot is very apt to think that he cannot hope to do on his land what Government can do on their stations with facilities of staff and money behind them. Most of the ryots are illiterate and leaflets are of no use to them. It is necessary actually to go to the ryot and show him, and not wait for him to come and be told. To this end agricultural exhibitions are held on all important occasions and festivals at which the countryfolk congregate. A most noteworthy advance in demonstration is the fitting up of Demonstration Motor Vans,

Three of these are now in use and cover, each a part of the presidency. Being on the road they are capable of penetrating the interior of the districts. They are equipped with a full set of exhibits which are displayed at each halting place. The Agricultural Demonstrator accompanying the van explains the exhibits to the cultivators. He delivers lantern lectures also. Other sister departments co-operate in this demonstration. The exhibits are changed and kept up to date to avoid staleness. By this method demonstration is carried to the very doors of the cultivators.

Trial Plots.

26. Conditions on a research station are of necessity, in many respects, different from those which prevail on the ryots' holding. It is, therefore, necessary in many cases to determine whether the same result can be obtained on the ryot's holding as on the research station or whether the result will be modified. In any case, it should be proved that a particular crop, method of cultivation, or manure will give an increased return per acre of approximately so much. This information can be obtained only by repeating the experiment on the ryot's holding and carrying it out with the same care. Plots in which such experiments are carried out on the ryot's land are called " Trial Plots." In this way the research side of the department is brought into direct touch with the ryots and they benefit by the discoveries made in the laboratories.

Demonstration Plots.

27. The precise purpose of the demonstration plot is to demonstrate a proved fact, not to elicit the fact, which is the function of the experimental plot on the research station and the trial plot in the district to which reference has already been made. It is, therefore, not necessary to give the same meticulous care to these plots as in the case of trial plots nor is it necessary always to record the yields, but it is necessary to see that the demonstration has a fair chance of success and that the cultivator is really interested and does most of the work himself. The cultivator no doubt feels that he is carrying out an experiment just as the small boy at school feels that he is carrying out an experiment when he is provided with a test tube containing lime water and a length of glass tubing and is told to place the latter in the former and blow through it and watch the clear liquid turn cloudy, but the demonstrator should feel like the teacher certain of the result. Any improvement thus demonstrated on the ryot's land, by the ryot, for the benefit of his brother ryots, carries easy conviction. There are thousands of these plots in the presidency and they deal with a large number of agricultural improvements, beginning with quite simple ones which need no extra expenditure on the part of the ryot, like thinly sown nurseries and economic planting of paddy, leading up to more elaborate ones where artificial manures are used. The general policy is adopted of beginning with simple improvements, and after the ryots have seen that these are really effective and their confidence gained, to lead

them on step by step and improvement by improvement till all that has to be taught is being demonstrated. There is a long list of improvements to demonstrate—the use of iron ploughs and better methods of cultivation, the use of better *mhote* buckets and wheels, the use of green manures instead of depending on the forest for leaf, better methods of making and storing cattle manure, and use of better strains of seed. In the cotton areas, demonstrations deal with new strains of seed which give bigger yields and better quality of lint, drill sowing and inter-cultivating with bullock power, better methods of irrigation which conserve water, clean methods of picking, and finally, co-operative ginning and marketing. In the sugarcane areas, deep cultivation, line planting, propping and wrapping, manuring and the use of iron mills and *Sindewahe* furnaces are demonstrated. In a large number of cases, enough monetary gains have been obtained so that the ryots can see just how much they can benefit from the improvements which are advocated.

Seed Production and Supply.

28. Of these improvements the spread of the seed of improved strains of various crops evolved by the department has met with great success. This success has brought in its train a very difficult problem, viz., the question of seed supply to meet the popular demand. As the Royal Commission on Agriculture in India say in their report, " In no respect is the difference between agricultural conditions in India and in western countries more marked than in regard to seed distribution. In most European countries, in the British Dominions, and in the United States, the distribution of new varieties of proved value is the work of the private agency. After the preliminary stage of testing has been completed and a variety has established itself in commerce the States take no active part in it." In this country, however, seedsmen dealing in seeds of crops do not exist, and the department would welcome any enterprise of this sort. For a very long time to come probably seed distribution must continue to be a burden on the Agricultural department though it is becoming an unduly heavy one. All methods which are now being used, welcome as they may be, are merely a compromise to tide over the period until the ryot has been taught to supply his own needs. The distribution of different strains of seed has been the greatest achievement of demonstrational activities. This has been a strong point in the past and will, no doubt, continue to be so for a long time to come. This is because the ryot is unable to maintain for himself a pure seed supply and is, therefore, in constant want of it. By the combined operations of departmental seed farms (in which the ryots grow pure crops, the produce of which are earmarked for distribution as seed) and co-operative seed distribution societies, it has been possible to initiate a system of seed supply which while meeting current needs will stimulate the setting up of private agencies dealing in crop seeds and eventually educate the ryot to be self-contained in the matter of his seed supply.

Permeation of Improvements.

29. When the Popular Account of the work of the department was written up in 1922 many a line of improvement had been narrated, and their financial aspects, both present and prospective, indicated. During the thirteen years following much development has taken place and substantial progress could be recorded in every direction. With regard to developments along new lines they are easily noted. With reference to further developments along old lines, it may be stated that not all developments are pursuable in terms of facts and figures for all time. Many improvements could be likened to a stone thrown in a still pond. The proverbial placidity of the ryot and his inborn tendency to continue to tread along his age-old path have been disturbed. Close on such disturbance there is a visible measure to the force of the disturbance in the ripples that circle out until after a lapse of time the whole surface has had this disturbance, only it is unnoticed at the periphery. In the case of many improvements a statistical pursuit must stop at a certain stage. This is illustrated pointedly in the case of the spread of the paddy strain G.E.B. 24. Its present area is infinitely more than any computation can possibly give. What should be the proper index is the general momentum that the improvement gets so that it can be safely deduced that it has got a hold where it could.

The Agricultural Demonstrator.

30. The centre of the general leavening influences of enlightened agriculture is the Agricultural Demonstrator. He is the officer in charge of the agricultural work in a taluk. A demonstration *maistri* often helps him in his work. He has a depôt in which he stocks superior seeds, suitable manures and improved implements. He has a stock of bulletins and leaflets in the vernaculars for distribution to cultivators. He organizes agricultural exhibitions and delivers popular lectures on agricultural improvements. To concentrate his work he chooses about eight centres of work in his taluk to each of which are attached four or six small villages and at these 40–50 villages he demonstrates all the improvements advocated by the department. He is constantly on tour and in intimate touch with the ryots. For such cultivators as seek his help he is their guide, philosopher and friend. Not having the trappings of power he is a real public servant. Personal contact is very essential in agricultural propaganda and a taluk is too wide for providing opportunities of such contacts. It is hoped that with the availability of more agricultural graduates the ideal of having an Agricultural Demonstrator in each *firka* will materialize. There will then be a group of public servants devoted to the service of the agriculturist who is after all *the* man behind the state.

Intensive Demonstration.

31. Till six years ago the activities of the demonstrator were extensive and work of an intensive and abiding nature was not possible. From 1931 came into force the system by which each

demonstrator was to have three or four central villages in which he should concentrate his work. The result was that the agricultural demonstrator was not known in the taluk beyond these centres of work, a situation that militated against his general usefulness in his taluk. In 1935 a scheme which aims at intensive propaganda with a view to bring to the door of every cultivator the advantage of adopting the improved methods advocated by the department was drawn up and sanctioned by Government. This scheme is intended to intensify the demonstration work in the district by the employment of a large number of literate demonstration *maistris*. These *maistris* are generally of the middle school standard of education. As an experimental measure, a start has been made in this system of intensive demonstration in the first circle for the nine taluks of the Vizagapatam district. These *maistris* are given special training at the Agricultural Research Station, Anakapalle, to properly equip them for the efficient discharge of their duties. Eight of them are attached to a demonstrator. They live in the villages along with the ryots. When the Agricultural Demonstrator goes from one village to another, the *maistri* living in the village will help the cultivators in the execution of the improvements advocated by him. This is expected to bridge the gap between the demonstrator at the taluk headquarters and the cultivators in the hamlets. The *maistris* not only devote their attention to the carrying out of agricultural improvements but also interest themselves in problems of general rural uplift like sanitation, co-operation and revival of cottage industries, all leading towards educating the villagers in the realization of the essentials of a happy rural life. It is now too early to say with certainty that this experimental measure is a success but the experience so far gained leaves no room for doubt about its utility. A much larger output of work is already seen. The existence of the agricultural department is being recognized by ryots all over the taluk and they have already begun to appreciate the services of the department and take advantage of the presence of the *maistris* amidst them. By the end of the five years for which period the scheme has been sanctioned, it is hoped that every village in the Vizagapatam district will be covered and every cultivator made to feel the usefulness of this department. In this band of trained propagandists will later on be found an organized agency for the execution of new schemes likely to be inaugurated by the Economic Council.

The Sections of the Agricultural Department.

32. In the foregoing paragraphs a survey of the salient features of the achievements of the Agricultural department with special reference to post-reform development have been given. In the following chapters popular accounts of the work of each of the sections of the department are rendered. As an introduction to these narratives a sketch of the organization of the department is given. The Agricultural department is under the Director of Agriculture, who is in general control of all the four items of work—

Education, Research, Demonstration and Marketing. He is assisted at his headquarters at Madras by a Deputy Director of Agriculture, an officer primarily devoted to the organization of propaganda and by a Marketing Officer. The Agricultural College at Coimbatore has as its Principal a senior officer who is assisted by a staff of lecturers. In close touch with the college is the Agricultural Research Institute, which has the following nine sections:—Chemistry, Systematic and Economic Botany, Paddy, Cotton, Millets, Oil-seeds, Entomology, Mycology and Engineering. Sugarcane research is conducted at Anakapalle and Gudiyattam. There is a Fruit Specialist at Anantarajupet in the Cuddapah district. At Ootacamund there is a Curator in charge of the Botanical Gardens and Parks in the Nilgiris. There is a Deputy Director in charge of Livestock Research at Hosur in the Salem district. The work of research and demonstration in the districts devolves upon the eight Deputy Directors, each of them in charge of the circles—Vizagapatam, Guntur, Bellary, Chingleput, Trichinopoly, Madura, Malabar and Coimbatore. Most of the Deputy Directors are assisted by Assistant Directors. The Central Farm at Coimbatore and some of the Agricultural Research Stations in the districts have gazetted Superintendents in charge of them.

CHAPTER II.

AGRICULTURAL EDUCATION.

(a) The Agricultural College.

The B.Sc. Ag. Degree.

33. It is interesting to note that the introduction of the B.Sc. Ag. Degree course at the Agricultural College, Coimbatore, practically synchronized with the inauguration of the Reforms. From the year 1920 admission to this course was restricted to candidates who had passed the Intermediate examination with science subjects as thier optionals. The college was formally affiliated to the Madras University in March 1922. Successful candidates were admitted to the B.Sc. Degree from 1923. To attract candidates of merit, the Government offered a number of scholarships of the value of Rs. 25 from 1920 to 1923. Subsequently as the number of candidates seeking admission increased, the award of scholarships was restricted to a few, mainly with a view to encourage backward classes. With the construction and opening in 1926 of the "Freeman Building," a separate building erected for the college, the annual admissions have been increased to 48, the maximum that can be accommodated in the laboratories and managed in field classes. From the number of applicants for admission, which has been on the average over 200, it would seem that the parents realize the advantage of the University education in agriculture. The Freeman Building is a big and handsome structure built close to the Research Institute and is fully equipped for teaching agriculture and applied sciences pertaining to agriculture. It is under the control of the Principal, who is assisted by a number of lecturers and assistant lecturers in each subject. The extensive Central Farm in which the college is situated, various breeding stations for important crops like paddy, sugarcane, millets and cotton, and an up-to-date dairy provide the students with excellent opportunities to learn the practical aspects of modern agriculture as suited to local conditions. The close association of the Research Institute with the college enables the teachers and the taught to be conversant with the latest developments of agricultural science and their practical application to South Indian conditions.

The agricultural education such as is being given in Coimbatore may thus be said to be almost an ideal of what sound teaching should be; where theory and practice go not only hand in hand, but where both keep pace with the latest developments. The course leading to the B.Sc. Degree in Agriculture is one of three years, and consists of a fairly advanced study in agriculture and its allied sciences, and has been considered as one of the best in India. The

instruction in farming has many peculiarities of its own. The students participate in all farm operations. They actually handle animals, fit up ploughs and work them in dry lands as well as in the puddles of the wet lands. They dig and cart manure, form plots, work the mhotes, irrigate the fields, raise seedlings and transplant them, harvest the crops, cart and thresh the produce, and in fact take part in every farm operation. They are also taken on tour to typical agricultural tracts of the presidency. This comprehensive training gives them a practical insight into their future work and fits them to be better masters of the farm and the farm labourers.

Another branch of agriculture taught is dairying. This includes the care of dairy cows and calves and the proper method of adjusting the feeds according to milk yields. The calves are not allowed to suck their mothers, but are separated from them soon after birth and are hand-fed with measured quantities of milk. This 'weaning' has two advantages. The feeding is regulated and diseases caused by over and under feeding are prevented. The calves thus weaned grow into healthy animals. The cows get accustomed to milking without calves and thus afford reliable data of milk yields. The students attend to milking of the cows and participate in the recording of milk yields. They are also given practical training in the disposal of milk on hygienic lines. The milk is separated into the more valuable cream containing butter, and the less valuable skim-milk containing little or no butter. The latter is fed to calves, or sold as such or converted into butter-milk. The former is boiled, cooled, and 'starter' is added. Butter is made from it the next day. The 'separation' reduces the quantity to be handled and makes for ease, cleanliness and efficiency in butter making. The students learn first-hand these advanced methods in dairying. The practical training in animal husbandry equips them to take a good care of the farm animals and to treat them for common ailments.

In Botany, besides systematic and physiological aspects, a special detailed study of crop botany is made. Every crop is studied thoroughly. A fair knowledge of the inheritance of characters in crops is imparted. The practical application of this branch of science is demonstrated to students in the paddy, sugarcane, cotton and millets breeding stations where advanced work on plant breeding along Mendelian lines is in progress. In Agricultural Chemistry, they get a good training in the analysis of soils, manures, fodders, oil-cakes, water and milk. The course in Entomology and Mycology is of practical value to help them take timely remedial and preventive measures against the pests and diseases of crops. Lastly the study of Engineering gives them a working knowledge of engineering useful in farm machinery and building constructions.

The graduates of this college are well fitted to serve in any branch of the Agricultural Department, in the Co-operative and the Revenue departments and also to work under Zamindars and landed aristocracy besides serving as science assistants in schools

and colleges. They are in a position to take up independent farming provided they own or purchase or obtain on favourable terms sufficient area of land of average fertility.

Short Courses in Agriculture.

34. The old "Short Course" giving practical training in Agriculture and leading to the "Certificate of Proficiency in Agriculture" was abolished with effect from 1924. Ten years later, in 1933, the new "Short Course" was introduced. This is of one year's duration and is called the Farm Management course. This has been inaugurated to serve the needs of the sons of well-to-do landowners who are likely to take more than ordinary interest in their lands. The students of this course are expected to take up the farming of their own estates soon after the training. Twenty-two students have so far undergone this training. Besides the above course, there are shorter courses in such popular subjects as bee-keeping, care of animals, dairying, insect pests and diseases, malt and jaggery making.

The Library.

35. The College and the Research Institute have a good library attached to them. There are now well over 30,000 volumes in it and about 2,500 publications are added each year. Reports and publications of the agricultural departments of various countries containing the regional aspects of agricultural problems are filed for ready reference. Current scientific periodicals and publications numbering nearly 300 are regularly received and circulated among the officers of the department to keep them in touch with the latest research done elsewhere. Besides, about Rs. 2,000 are spent every year in purchasing new agricultural books that are being published. In addition, English translations of important scientific articles appearing in foreign languages are filed in the library for the benefit of research workers. Information is frequently furnished to other libraries, institutions and also to individuals, giving full particulars of books on various subjects. Though the library is mainly intended for the departmental officers, non-officials and other scientific workers are helped with books and suggestions relating to their problems. A technically qualified officer is now in charge of the library to help the officers and students with full bibliographical information on special subjects.

(b) The Central Farm.

The College Estate.

36. The Agricultural College and the Agricultural Research Institute are situated in a big estate over 450 acres in extent, 3 miles to the west of Coimbatore. Many of the officers and staff in the College and Institute are housed on this estate, which is under the

administrative control of the Principal, who has the assistance of an Estate Committee. The cultivated lands of this estate constitute the Central Farm.

The Central Farm.

37. This Central Farm is primarily the farming area on which the students learn various methods of farming and the many operations in connexion therewith. A part of this area is made available for the use of such officers at the Research Institute as need land for experiments. The cultivated area is about 285 acres in extent and includes a variety of soils, black, red and loamy. There are dry, garden and wet lands. The wet lands, 45 acres in area, are irrigated from a tank fed by a channel from the river Noyil and are devoted to the cultivation of paddy, sugarcane, plantain and some root crops. Black soil of a medium quality covers 110 acres; 130 acres are red soil. These are partly dry lands and partly garden lands irrigated by wells and growing a variety of irrigated crops. Crops of one kind or another can, at all times of the year, be seen on the ground. A small botanic garden serves the needs of botanical and horticultural instruction.

Different methods of conserving and storing cattle manure are adopted at the cattle yard of the Central Farm to meet the heavy manurial requirements of the vast cropped area and incidentally to demonstrate the practical and profitable methods of preserving cattle-dung and urine, and also increasing the available organic manure through the proper use of litter. Electric power is utilized to demonstrate the many uses to which cheap power can be put on a farm of this magnitude.

Attached to the Central Farm is a Veterinary Hospital in charge of a Veterinary Assistant Surgeon for the training of students and for the benefit of the Farm animals. Outside animals are also treated free.

Objects of the Farm.

38. The objects of the Central Farm are (i) to provide facilities for practical work to the students of the College and give them a good working knowledge in the practical aspects of farming; (ii) to provide facilities for the many specialists at the Research Institute to conduct field experiments; (iii) to provide fodder for the dairy and for the working animals. The system of cropping adopted on the farm is therefore so adjusted that all the above objects are achieved. The opening of separate research stations for the study of paddy, cotton, millets and sugarcane, in close proximity to the Central Farm has gradually tended to the confining of breeding and to some extent cultural and manurial experiments on such crops to the particular crop-stations, the Central Farm restricting its activities to the multiplication of such improved strains as the specialists release. Agronomic experiments of a general nature and trials of various improved strains on a field scale have, however, been continued as before.

Wet Lands.

39. The main crop in the wet lands is paddy. Green manuring is regularly practised in the cultivation of paddy. It has been found possible to get about 26,000 lb. of green matter by growing *dhaincha* or *pillipesara* at a cost not exceeding Rs. 2–8–0 per acre. Paddy seedlings, seedlings from not more than five cents have been more than sufficient to plant an acre, if planted singly, and yet easily yield 3,000 to 4,500 lb. of grain per acre. From the study of paddy yields during the past 25 years it is seen that from the year 1923–24, there has been an increase in the average outturn which it is safe to attribute to the cumulative effects of improved cultivation and treatment carried on since the farm was started. This average is maintained with but a slight rise or fall due to seasonal influences. This, coupled with the growing of the heavy yielding strains evolved at the Paddy Breeding Station, has resulted in a net profit up to Rs. 200 per acre in 1929 when paddy was selling high. Even in 1934 when the price was very low it has been possible to obtain a profit up to Rs. 80 per acre.

Garden lands.

40. Similarly in the case of garden lands, new strains of *ragi*, *cholam*, and Cambodia cotton have given very high yields and these are being grown on large areas and distributed to the district officers. An idea of the rich yield likely to accrue from a careful combination of cultural and manurial treatments can be had from the following acre yields of crops, Cambodia cotton—1,400 to 1,900 lb. of *kapas*, *ragi*—3,000 to 3,600 lb. of grain, and *cholam*—1,800 to 2,600 lb. of grain. Many varieties of sugarcane are under trial and some of these have yielded up to 60 tons of canes per acre. The growth of green manure crops on garden lands has obviated the necessity of heavily manuring them with cattle manure for each crop and has tended largely to release appreciable quantities of this manure for application over an extended area including portions of the dry lands hitherto left unmanured.

A large variety of cereals, pulses, oil-seeds, root crops, fibres and drugs are raised annually as specimen crops for the instruction of students.

Fodder.

41. The trials with various fodder crops for the benefit of the dairy cows and working animals have proved that maize is by far the best green fodder for increasing the milk yield. Fodder cholam, lucerne, guinea grass, elephant grass, and recently a new crop allied to maize ' teosinte ' are all being grown at various periods and fed to the animals. That heavy cuts could be obtained from these crops is demonstrated from the following acre yields :—Fodder *cholam*—40,000 lb., maize—30,000 lb., *cumbu*—30,000 lb., teosinte —35,000 lb. and lucerne—30,000 lb. It is found that in the case of guinea grass it gives a heavy cutting after the outbreak of the

south-west monsoon and the cuttings get reduced as the cold weather approaches. But lucerne—a leguminous crop—behaves differently in point of growth. In the hot months, the growth of lucerne gets arrested, but the cuttings become heavier as the cold weather approaches.

Advantage is taken of the heavy cuts of fodder obtained from the Central Farm to demonstrate the preparation and use of silage for the dairy herd. This silage comes in handy in the summer months as succulent cattle feed. An experience in silage making may be mentioned here. In 1927 silage was made of 38,908 lb. of green fodder *cholam*, 2,592 lb. of sunnhemp and 1,736 lb. of green *dhaincha*. The ensilage obtained was 35,698 lb. the loss in preparing silage being 17·5 per cent.

Fruits, Vegetables and Flowers.

42. A new development of farming at the Central Farm is the starting of an orchard in an attempt to study the possibilities of fruit growing and thus give the students and visitors a demonstration in fruit culture. This has been attended with very promising results. The experience of the last five years shows that the various citrus varieties, China, Mozambique, Batavian, Washington-Navel, and Santhras can profitably be grown under Coimbatore conditions; so also mango, fig, guava and pomegrante. Fig yields a quick and heavy monetary return.

A vegetable garden is maintained close to the orchard and helps to afford experience in kitchen gardening to the students. The chief vegetables grown are—tomato, ladies-finger, brinjal, beans, cabbage, cauliflower, beet-root, knol-khol, carrot, onion and garlic. A feature of the kitchen garden is the heavy yield of tomatoes and their ready and profitable sales. The surrounding cultivators have begun to realize this especially as the fruit commands a ready sale in the Coimbatore market and is much in demand by the educated classes.

Of flowers, jasmine and rose have been planted up and are doing very well. The rose yields an appreciable revenue, its flowers finding a ready market.

Dairy and Livestock.

43. The dairy attached to the Central Farm is a useful institution for imparting instruction to students and supplying dairy produce. The maintenance of stud bulls has been of immense value to the cow owners of Coimbatore and the neighbouring villages. On an average about 10 bulls were annually maintained at the dairy. The number of services conducted ranged from 400 to 500. Owing to the availability to the public of stud bulls maintained by the Coimbatore Municipality and the Central Jail, the number of stud bulls at the dairy has been reduced. Pigs and poultry form useful adjuncts to the dairy. The poultry business is a profitable line of

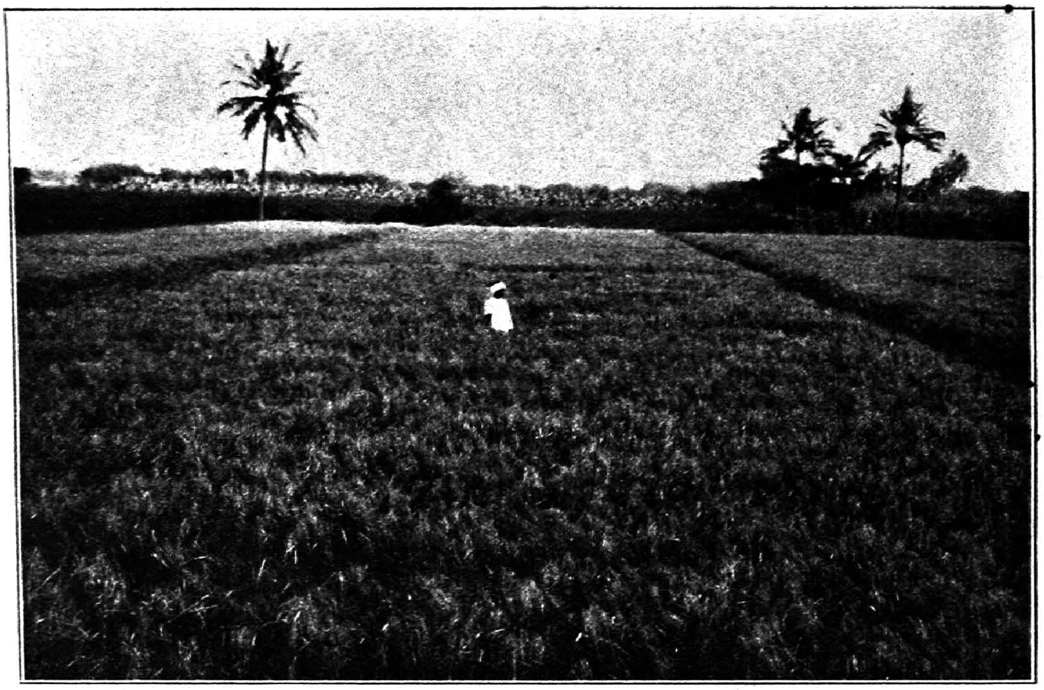
farming. White Leg-horns, Rhode Island Reds and Light Sussexes are popular here, attracting many visitors. A large number of birds are being sold besides eggs for hatching purposes.

Activated Sludge Plant.

44. Sanitary Engineers design schemes to drain away sullage water, and along with it precious mineral salts and organic matter, all finding their way eventually to the sea. To convert this waste product into a valuable manure the latest development is what is termed as the 'Activated Sludge Process' in which purification is effected by the æration of the organic matter present in the sewage. The air is forced through the liquid in the presence of an accumulation of sludge. The Activated Sludge plant at the Agricultural College deals with the waste water of the estate and uses a portion of the night-soil obtained. It consists of a series of masonry tanks of various sizes where the night-soil is mixed with the sullage water by the process of activation with air pumped under pressure. The resulting products are, (*a*) effluent which is like clear water; it has a high manurial value and is very useful for the irrigation of crops, (*b*) sludge—a light solid matter of dark grey colour, free from any obnoxious odour or even the slightest suspicion of its being a product from human excreta. This sludge can be freely handled and is specially useful for manuring garden crops and fruit trees. This experiment in the scientific and systematic disposal of sullage water should prove of value in the installation of similar plants in urban areas with its attendant beneficial effects on the cultivating population of the suburban zone.

Wood Preservation by Fal-Kamesam Process.

45. Wood and wooden parts are a necessity to the farmer. Their proper preservation tends to economy. They are liable to rapid depreciation through moulds and insect attack. To preserve wood against such depreciation a plant is installed in the workshops at the College for conducting wood treatment experiments with chemicals. The treatment consists in injecting a solution containing Arsenic pentoxide, Potassium dichromate and Copper sulphate under pressure, so that the piece of timber subjected to the treatment is completely impregnated with the chemicals throughout its section. The effects of such treatment on the resistibility of ordinary country wood against insect and fungus attacks is being studied. The study is now primarily confined to the use of jungle wood for fence posts.



A CROP OF PADDY STRAIN G. E. B. 24.

[To face Chapter III.

CHAPTER III.

AGRICULTURAL RESEARCH.

(a) Agricultural Chemistry.

Routine and Advisory Functions.

46. The chemistry section of the Research Institute has two main functions—(i) routine and advisory, and (ii) research. The routine work consists of the analyses of various samples of soil, water, manures, feeding stuffs, etc., which are received either from the general public or from officers of the agricultural and other departments. For example, the Public Works Department sometimes sends samples of water for analysis in order to test if they are fit for irrigation, or to ascertain what is borne in such water. Officers in charge of district agricultural stations frequently need the help of the Chemist in analysing samples of manures, soils, and agricultural produce. They work in collaboration with him when laying down experiments to test the value of different manures. Other experts at the research institute also seek his technical advice. Trained assistants are sent to the various research stations to analyse sugarcane at the time of harvest. For the dairy at the college frequent analyses of milk are made. Soil analyses are made for the general public, and suggestions are given as to how the land may be improved, and what manure should be applied. The advice given is also communicated to the circle officer concerned so that the ryot may be visited and further advice given to him on the spot by the district staff.

Research.

47. In the research side of its activities the section has expanded to a very great extent since the year 1922 and now consists of the following branches :—I. Soil Survey, II. Soil Physics, III. Physical Chemistry, IV. Plant Nutrition, V. Bacteriology, VI. Animal Nutrition, and VII. Malting. Each branch tackles special problems and is in charge of a gazetted officer. The Imperial Council of Agricultural Research finances two schemes, viz., (a) Animal Nutrition, a scheme spread over a period of five years, and (b) Malting, spread over three years. A very extensive programme of research is thus in progress.

Soil Survey.

48. Soil surveys of agricultural tracts are carried out to get information as to the status of fertility of those tracts. Such surveys give useful information on the deficiencies and sufficiencies of plant foods in those areas. In the past such surveys were made of the

Cauvery, Tanjore and Kistna-Godavari deltas, and of a part of the Malabar district.

During the past three years soil surveys have been mainly in connexion with irrigation projects, contemplated by the Government. A survey of the Lower Bhavani area (Coimbatore district) and a preliminary survey of the Cauvery Mettur Project under the Grand Anicut canal have been completed. A detailed soil survey of the Tungabhadra Project area has just been completed. These surveys were undertaken at the instance of the Irrigation branch of the Department of Public Works with a view to determine the suitability for irrigation of the lands proposed to be commanded by the projects before proceeding further with them. The soil surveys were therefore elaborated so as to study the moisture relations of the soils, their profile structure and salt contents with a view to obtain data on the suitability of the soils for irrigation, and to assess the probable effect of irrigation in inducing or reducing salinity.

The Lower Bhavani and Cauvery-Mettur areas were found to have very porous soils, quite suitable for irrigation, though their status of fertility was low. The Tungabhadra area consisting mainly of black soils, brings up new problems on the irrigability of a heavy clay soil. The field work on the 2,000 square miles of country in the districts of Anantapur, Bellary and Kurnool has been completed, and analytical work on the large quantities of samples collected is just over. Preliminary examination has shown that these soils are capable of irrigation with caution and discretion.

It is needless to emphasize the importance of the above investigations. They are useful to the state in giving it guidance before the expenditure of huge sums on irrigation projects is incurred. The data collected by these surveys will also be helpful in advising the agriculturists of the area to be irrigated in their future cropping. Costly mistakes can thus be avoided. The disastrous effects of famines can be mitigated and the country will thus secure the maximum benefit possible from well-planned irrigation schemes.

Soil Physics.

49. The physical properties of soils are under intensive study at Coimbatore and Hagari (Bellary), with a view to find ways and means of conserving moisture. One of the limiting factors in crop production in the dry area of this presidency, i.e., the Ceded districts, is the lack of rainfall. The object of the study is to find methods of utilizing the scanty and often precarious rainfall to the best advantage by suitable tillage and soil management.

Composting of Waste Materials.

50. The making of composts from a large variety of waste material—human and vegetable—has been successfully carried out by a simple method involving little or no experience and requiring no specialized technical skill. By this method waste material of any

kind is pitted in layers, each layer being sprinkled with mall quantities of bone-meal and moistened with fresh cow-dung water. When the pit is filled up, the material is covered over with a layer of mud plaster and allowed to stand for a week or two. Thereafter the material in the pit should be stirred occasionally and in about three months' time material would have decomposed into a manure fit for application to the land. A similar process is used with night-soil with the addition of copper sulphate to render it odourless. The quantity of cattle manure available is very inadequate, and if the large quantities of waste materials available are properly utilized, many acres of land now going unmanured for years can be fertilized and made to yield larger quantities of a superior crop.

Manuring and Crop Quality.

51. A piece of research of the most far reaching importance that has been carried out by this section is that on the effect of manuring on crop quality. Till now the quantitative effects of manuring have been the subject of study and the qualitative effect was not considered. As a result of work in the section it has been found that the latter is no less important than the former. A crop manured with cattle manure has been found to have a superior nutritive value. This work has since been followed up and attempts made to find out the exact way in which organic manure improves the quality of a crop. The work of McCarrison and Viswa Nath suggested that the vitamin content of the resulting crop was increased by an application of cattle manure while inorganic fertilizers produced a crop of low vitamin value. Subsequent work has shown clearly a differential nutritive value not entirely traceable to vitamins. The herbage of *ragi* grown with cattle manure and no manure was compared as to the digestibility of its protein fractions, and it was found that the ' cattle manure ' herbage had a superior digestibility. These findings led to further work on the possibilities of a differential synthesis of protein in the crop when grown under different manurial treatments. Work is in progress and results so far obtained indicate that while organic manure stimulates the synthesis of one type of protein in cereal grains, inorganic manures appear to favour the production of another type. This would explain the differences in nutritive value of crops manured differently, since the various groups of proteins are useful to the animals to different extents.

If as a result of this investigation it is possible to establish the exact way in which manures affect crop quality it will become possible to manure a crop to increase its usefulness as a human or cattle food.

Improvements in Jaggery Making.

52. The making of jaggery is an industry of great importance in this presidency, and being mostly on a cottage industry scale, is practised by the agricultural class in nearly every district. One of the important features that determines the marketing value of

jaggery is its colour and hardness. Jaggery making as it is being practised in some areas is primitive and yields a product dark in colour, soft in texture and poor in market value.

The factors that are known to cause a dark colour and softness in jaggery are numerous. Some of them are the poor quality of canes used for crushing, the presence of certain non-sugar organic compounds, and large quantities of colouring matter in the rind of the cane. Investigations on the improvement of the quality of jaggery were undertaken and it was found that by the simple method of filtration through a bed of activated carbon, the colour and structure of the resulting product could be improved to a very large extent. The use of active carbon for the clarification of sugar solution has been long in use in the manufacture of white sugar, but the active carbon then in use was an expensive product that made its use prohibitive in the making of jaggery. Active carbon was, therefore, made from paddy husk, a by-product of the rice milling industry and not used for any other purpose. A process was evolved which involved a simple furnace and activation of the burnt husk by caustic alkali. This method has now been brought to a state suitable for adoption even in villages. It yields a product of efficiency almost equal to that of the imported active carbons and at a considerably lower price. The advantages of the method are its simplicity so that it can be adopted with the help of very little technical labour, and its applicability with slight modifications to other materials like groundnut husk and saw dust.

The active carbon having been obtained at a price which will not unduly raise the price of the jaggery, it was used for filtering the cane juice before boiling. The active carbon, by virtue of its large surface and colloidal properties, absorbs most of the colouring matter and other undesirable colloidal substances from the cane juice, which when boiled and converted into jaggery gives a light coloured, hard product instead of the dark soft jaggery.

This process has been demonstrated throughout the presidency during the past two years, and has met with a large measure of encouragement from the ryots. The light coloured jaggery has been called " cream jaggery," by reason of its creamy colour, and has been found to sell at a premium of about 20—25 per cent when compared with ordinary jaggery.

When the total value of jaggery produced in this presidency is considered, an improvement in price of even half that now commanded by " cream jaggery " will mean an appreciable increase in the income of jaggery producers. Jaggery is moreover a product of local importance and will continue to find a steady market irrespective of international trade movements.

Fruits.

53. During the past two years a study of the two important fruits, mango and plaintain, has been in progress. The chemical composition of some of the varieties of mango and their vitamin

contents have been determined. The Banganapalle mango was found to be an excellent source of vitamin A. Studies are in progress on the preservation of the plantain in a dry condition, and the results obtained so far are very encouraging. When perfected, this method of preservation will make it possible to bring the highly nutritious plantain fruit within the reach of those living in areas where that fruit is not easily available.

Animal Nutrition.

54. No data exist to indicate the real food requirements of the cattle of this presidency. Stock breeders and cattle owners feed their animals to the extent that they can afford to do so, or according to age old custom. In western countries the needs of the animals have been studied and standards set up for each class of animals. Till now these western standards—American or Continental—were the only ones available for adoption here.

A start was made in 1928 to study the requirements of working bullocks at Coimbatore. Various combinations of the available fodders and concentrates were tried on Ongole and Kangayam bullocks, kept in a resting condition, and with work. A long series of experiments have been conducted in which records were maintained of the protein entering and leaving the animal system, the difference between the two being the quantity retained in the body of the animal. A study of the quantity of proteins or its breakdown products in the urine, which represents the quantity of protein used up in the body, revealed the real requirements of the animal. The quantity of protein used up in the body is the quantity of tissue used up in the performance of the vital functions of life. These two quantities being known, i.e., the absorbed protein and the real requirement, attempts were made to equate them and to note whether the animal suffered loss of body weight. This was achieved repeatedly when the absorbed fraction and the requirements of proteins were almost exactly equal without loss of body weight of the animal. This level of feeding was taken as the requirement of the animal, and repeated experiments were conducted with the animal at rest and working, to establish the level of nutrition at which the animal is receiving sufficient protein to meet its basal requirement. It was found that for a bullock of 1,000 lb. live weight, the requirement for a resting condition was 100 grams digestible protein and for heavy work, 300—350 grams. Comparing these with western standards, when a 1,000 lb. bullock has a requirement of 300 grams for rest, it will be readily seen that the Ongole or Kangayam bullock requires only one-third of that quantity for rest and about that quantity for heavy work, and that the local breeds of bullocks are very economic feeders compared to western breeds. This work has shown that the wholesale application of western standards of cattle nutrition to our cattle would result in serious wastage and consequent loss to the stock breeder and cattle owner.

Malting of Cholam.

55. An investigation has just been started on the malting of *cholam* for the manufacture of infant and invalid foods. This work is an extension of the preliminary work done some years ago, and aims at a systematic study of the fundamentals involved in the process of *cholam* malting. It aims at the production of a standardized malt food of marketable quality that can compete with the imported material.

(*b*) Botany—Systematic and Economic.

The Madras Herbarium.

56. The Madras Herbarium originally located at Madras and subsequently for some time at Ootacamund is now located at the Agricultural Research Institute, Coimbatore. It is one of the best herbariums in India. This herbarium was the centre, as it were, from which, due to contact with the Agricultural Department, there ramified the many branches of Economic Botany including specialization in crops. Specializations in such important crops as cotton, sugarcane, rice, millets and oil seeds are the first fruits in this Economic Botany. There are other crops of value, one of which, bananas, is receiving intense attention.

Bananas.

57. The study of bananas commenced with a survey of the crop. About three-fourths of the presidency has been surveyed in this connexion and more than 400 local varieties have been collected and grown at Coimbatore and have been tentatively classified into about 40 varieties. There is a great confusion in the names of varieties, the same variety being called by different names in different tracts; similarly the same name connoted differing varieties. The classification done at Coimbatore will help in the adoption of a standardized nomenclature applicable to all the varieties of the presidency. The study of the keeping quality of the plantains, and of making flour and fig from it are in progress. There is a large demand for plantain suckers. One thousand six hundred suckers were distributed in 1934. This intensive work at Coimbatore is keenly watched by other workers in the world and indents from them for suckers have been met. There are immense possibilities for the study of marketing such a valuable fruit crop in Northern India, where it is sold at a high cost. The field in the hybridization of different varieties, combining the keeping qualities of one variety with the taste of another, is still unexplored.

Grasses.

58. Very useful work has been done in studying the habits and conditions which favour the growth of the different grasses which go to make up our grazing areas. A survey of some important

pasture areas resulted in the collection of over 170 species of grasses. A dozen promising species have been selected and are under trial. Some of the hill grasses which have been introduced into the plains are thriving well. This line of work forms a very useful preliminary to the study of the improvement of grazing areas and of the forage plants in this presidency. A Hand-book of Some South Indian Grasses has been published.

Weeds.

59. Much useful work has also been done on the study of the weeds which are found on the different classes of cultivated land. This study shows how such weeds are propagated and how they spread. Valuable information has been obtained indicating methods of cultivation by which the farmer can most effectively eradicate these weeds. A Hand-book of Some South Indian Weeds has also been published.

Other Economic activities.

60. In the course of the survey of pasture grasses it was noticed that there were plants poisonous to livestock. One hundred and twenty-seven of these were selected from the herbarium and annotated. Similarly 186 medicinal plants were dealt with. In the course of work on insect and fungoid diseases that attack crops, it was found that such diseases find convenient hosts in the off-season in wild plants and many of these have been at the request of the Entomologist and Mycologist identified at the herbarium.

Systematic Work.

61. Apart from the above economic activities, the routine work of the section includes collection and identification of specimens, incorporation of specimens into the herbarium, distribution of duplicates under exchange relations, loan of specimens to recognized institutions and individuals in connexion with special study, revision of the nomenclature of the Madras plants in the light of recent advances in that direction, forwardal of Madras specimens to institutions in and out of India for purposes of correct identification of difficult and un-matched sets of specimens, and lastly, supply of information on questions bearing on the value, economic or otherwise, of plants, accompanied sometimes with the actual supply of plants, seeds, etc. The magnitude of the outturn of work in the section will be evident when it is noted that in the period under review over 27,000 sheets have been incorporated into the herbarium, nearly 24,000 identifications made, over 3,500 specimens spared to others and a similar number sent to Kew for the preparation of the Madras Flora by Mr. Gamble. There are thus world wide contacts on matters of interest in Economic and Systematic Botany.

(c) PADDY.

Paddy Breeding Station.

62. Rice is the most important article of diet of the people of Madras and hence the crop occupies a pre-eminent position in the agriculture of the presidency from early times. Out of the 39 million acres cropped in the presidency 11·5 million acres are covered by rice and this forms nearly 40 per cent of the area under food crops. Though certain cultural and manurial experiments with rice were being carried out in the agricultural stations from the early days of the department it was in 1913 that a Botanist was appointed to study the rice plant in all its aspects including breeding. In 1915 he was provided with a separate Paddy Breeding Station, at Vedapatti, 3 miles from the Agricultural College, Coimbatore. The main object of this station is to improve the yield of paddy besides fundamental work on the inheritance of various botanical characters of the rice plant.

Breeding.

63. The main line of plant improvement is by breeding of high yielding strains from the popular varieties by what is known as 'pure line selection.' The principle of the method is the isolation of the best types and the multiplication of the same after testing them for yield for a period of three or four years. The method though simple involves a lot of minute attention to details, care and efficient supervision at every stage of field trials : so that a good equipment and a trained staff are essential for the successful working of a breeding station.

Sub-stations.

64. Within a few years of successful work with the evolution and distribution of strain No. GEB. 24 from Coimbatore, it was realized that improvement work for one tract may not hold good for another rice tract due to different climatological factors and agricultural conditions. So the expansion of this section during the last decade took shape in the opening of sub-stations one in each of the important rice tracts of the presidency. The Aduturai station was started in the year 1921 to serve the Cauvery delta and the Cauvery valley where over a million acres are under rice every year. For the Godavari and Kistna deltas, growing rice over an extensive area of 1·75 million acres, a station at Maruteru was opened during the year 1925. The Pattambi station came into existence during the year 1927 to serve 1·47 million acres of the paddy areas in Malabar and South Kanara. The inception of the fourth station, temporarily for five years, at Ganjam in the year 1932, was made possible by the funds placed at the disposal of the Madras Government by the Imperial Council of Agricultural Research. The progress in the establishment of such stations got a set back however

due mainly to the financial depression and also to some extent to the fall in the price of rice. Under normal conditions the Chingleput tract should also have had a station by now, and it is hoped that when conditions improve the starting of more sub-stations for the tracts not tackled hitherto will be undertaken.

Improved Strains.

65. The breeding work at every station started with a survey of the tract, the collection of the common and popular varieties and the evolution of high yielding strains from the most important of them. Since the publication of the last report in 1922, when two strains, GEB. 24 and R.S. 76 (Adt. 1), were under distribution, the activities of the section can be gauged by the number of strains evolved at the main as well as at the sub-stations. Ten more strains from Coimbatore, 10 from Aduturai, 9 from Maruteru and 6 from Pattambi were released during the period under review. These are spreading rapidly in the province replacing the orginal unselected varieties grown by the ryots before. Though yield has been the main criterion in the selection work, other valuable economic characters like good quality of rice, earliness, etc., have also received attention. The increase in yield recorded by the strains have been found to be anything from 8 to 25 per cent. Some of these strains in addition to yield possess other valuable characters. There is a wide choice of strains suited to a varied set of conditions. Rice growers can have the most suitable strains on consultation with the officers in charge of these stations.

While the sub-stations, generally have a collection of all important varieties of the tract, at the headquarters breeding station, a valuable collection of rice varieties from the different districts, from other provinces and even from other countries has been steadily built up. This collection has now exceeded 1,200. Accurate records of all the economic and morphological characters of all these varieties are maintained and they form a life herbarium of material from which it will be possible to pick out the best for trial against the existing improved strains or to use some of these as parents for hybridization work for definite economic characters such as disease resistance or promising yield attributes like earliness, tillering, length of panicle, etc.

Hybridization.

66. Hybridization is more tedious than simple selection work and to get at successful results a good knowledge about the inheritance of the various characters in the plant is a necessity. The inheritance studies may be considered academical to begin with, but it may be stated without fear of contradiction that the indiscriminate choice of parents for crossing without an adequate knowledge of how the characters are inherited have always ended in failures. In the crossing work, the first cross and subsequent

generations from it have to be studied carefully and suitable types showing the desirable combinations of characters fixed. While it takes ordinarily five to six years to evolve an improved strain from a variety by mere selection, evolving a strain by hybridization may take from 8 to 10 years. When it is remembered that regular breeding work in rice started in Madras only 22 years ago, that so many new strains have been evolved during this period must be considered no mean achievement. Intensive studies on the plant have shown that strikingly high yields cannot be attained by simple hybridization. The characters that go to make the yield are very complicated in their inheritance and do not lend themselves to simple synthesis. There is greater scope however, for improving other useful ancillary characters like disease resistance, earliness, stiffer straw, etc., which all contribute to yield indirectly, by suitable crossing.

Among the strains evolved by hybridization, Adt. 8 is one which in addition to giving a slightly bigger yield than one of its parents, Adt. 2, is shorter in duration by a fortnight and is particularly suitable to portions of the Cauvery delta where water scarcity either in the beginning or towards the end of the paddy season is a great consideration.

In the Tanjore district a heavy yielding variety *Korangu samba* is sometimes seriously subject to a fungus disease (*Piricularia oryzae*), and work was started in the main station to evolve a disease resistant strain by crossing it with other varieties known definitely to be resistant to the disease. Success has been achieved in this direction as already two strains have been evolved which are found to be resistant to the disease and at the same time give yield increases of 10 to 20 per cent over *Korangu samba* even when the latter is free from the disease. Then again our rice plants usually have weak straw and any intensive treatment of the crop to improve the yield results in the premature lodging of the crop. It was found that some of the Burma types in our collections, though they were not heavy yielders had usually stiff and strong straw, and work was soon undertaken to cross some of our heavy yielding but weak strawed strains with the Burma types, and now after about 8–10 years' work, some strains have been obtained which in addition to giving a higher yield than Co. 3, one of the parents, possess strong straw. In addition to mere increase in the gross output of a variety, attempts are also made to improve the quality of rice as required by trade. Sometimes the mere introduction of some varieties from other centres may meet this requirement. Certain Patna rices from Bengal have been introduced and tried in Coimbatore and these are found to have a better quality of rice than our *kar* varieties and at the same time give higher yields than the latter. In Coimbatore for the last two seasons they have done considerably better than Co. 10 of the same duration when grown in August, and district trials are under progress to find out what seasons and tracts may suit these best in our province.

Supply of Seed.

67. At present the seed is distributed to cultivators in the various parts direct from the Agricultural stations. There are also special seed farms run by private individuals with the help of the department but still only a fraction of the demand for improved seed is actually met every year. The popularity of the strains is so great that it is not possible for the station with limited area to meet the demand from the public every year, though there are co-operative seed farms who grow our seed in the districts. If only some effective private organizations take up this work of seed multiplication, the spread of these strains will be more rapid and the benefits realized earlier.

Spread of Strains.

68. The province has usually a deficit of one lakh of tons of rice which she has to import from outside. A systematic spread of the improved strains in the province should make it more than self-sufficient.

Taking an increase of 10 per cent as a modest estimate and if the whole area of 11 million acres under rice is cropped with improved strains, the normal production of 5 million tons of rice will be raised to 5½ million tons, the increase amounting to a money value of 30 million rupees. It is not possible to have a correct estimate of the spread of strains as in addition to recognized sale of seed sent from the station and from the seed farms, there is always private distribution of seed among the cultivators themselves. Sometimes when a new strain is grown by a ryot in a tract it attracts the attention of the neighbouring ryots and when its superiority is recognized its spread becomes very rapid making it almost impossible to keep trace of it. To give an example of the rapidity of this kind of spread of strains, a Coimbatore strain GEB. 24 grown on 5 acres in Palghat in 1926–27 increased to 90 acres in 1927–28, 500 in 1928–29, 2,000 in 1929–30 and to as many as 15,000 acres in 1930–31.

Another instance of the rapid spread of GEB. 24 in Mysore may be mentioned. A small quantity of it was sent to the Mysore Department of Agriculture in 1924 at their request for trial there. It is now stated that it has replaced completely all the local varieties and it is the chief rice variety for the whole province occupying several thousands of acres.

From the figures available for the Tanjore tract, it may be said without any fear of contradiction that almost the whole of the area of 6½ lakhs of acres for which strains have been under distribution for the last ten years is now cropped with the departmental seeds. In addition to research in the evolution of strains and in the economic raising of the rice crop by suitable manurial and cultural practice a certain area, though restricted, is devoted for the multiplication of strains and every year the amount of strains distributed

to ryots from the rice research stations is more than enough to cover 7,300 acres without taking into account the spread of strains through other means. The money value of the increase in outturns in this area can be estimated to be nearly 50,000 rupees annually which is more than half the total amount expended on all the rice research stations including the pay of the staff.

Cultural and Manurial Experiments.

69. The question of improvement does not cease with the evolution of strains. There is another important aspect, that due to ‘ nurture ’ as distinct from ‘ nature ’ involved in breeding. Under this comes the problem of cheap and efficient supply of food material to the crop by carefully planned cultural and manurial experiments best suited for the individual tracts. Such experiments are being conducted in all the breeding stations with the sole object of assuring monetary gain to the cultivator either by increasing the outturn or by reducing the cost of cultivation. The advocacy of economic planting of paddy with the reduction of seed rate by the department has found favour with the cultivators and it can safely be stated that this practice has extended to all the parts of the presidency.

For the poor soils of Ganjam it has been found that applications of green leaf increased the outturns significantly and it can be said with authority that the application of a bulky organic manure like green leaf is a very good practice for paddy, and wherever the conditions are favourable for growing green manure crops such as sunnhemp and *dhaincha*, it is the cheapest and best form of fertilizing rice fields to supply nitrogen to the crop.

Artificial manures, such as sulphate of ammonia and super phosphate, are also useful, but their application depends upon the economics of rice growing, and especially when the price of rice has fallen low, the cost of these manures is not favourable for application to the rice crop. Experiments conducted in all the stations regarding the time of application of readily available nitrogen in the form of ammonium sulphate have shown the advisability of applying the manure one month after planting in the case of a medium duration crop and two months after planting in the case of a long duration crop. It has been found that the optimum yield is obtained when the spacing is about 4½ to 6 inches in Pattambi and Berhampore, about 6 inches in Coimbatore and about 8–9 inches in Maruteru. While the above spacings are for varieties of five months' duration and more, for short duration varieties the optimum spacing is never more than 3–4 inches for any locality. In the Godavari delta, such modification of cultural practices as the early sowing of a specially evolved second crop short duration strain, Mtu. 9, and restraining the growth by the dry treatment of seed beds and the planting of the seedlings in February enabled the early maturity of the crop before the closure

of the canal, together with the advantage of the crop being free from stem borer infestations to which the ryots' crop always succumbed when planted earlier than February.

Cultivators are well aware of the beneficial effect of green manure but the cost of collection and application, and the availability in sufficient quantities at a time when they are in a hurry to complete sowing and planting operations, restrict the area of application, thereby, keeping down the level of the yield. The growing of a green manure crop for manuring the rice fields has been found to be economical, and it is found that the cost of 1 lb. of nitrogen in green manure raised on the land was about 2½ annas while if it is bought from outside in the shape of fertilizers it is about 10 annas.

Nutritious Types.

70. While breeding is an effective means to increase 'the quantity of total output,' it does not overlook the possibility of evolving nutritious types. It has been found that the bran layer and embryo contain most of the nutritive ingredients, the most important of which is vitamin B, the deficiency of which in food is the cause of the disease beri-beri. As the poorer classes are solely dependent on rice diet without much of supplementary food to supply the deficiency, it should be our endeavour to conserve all the ingredients by advocating the consumption of unpolished rice. Researches are underway to evolve better types with a thicker bran layer and to find out better methods of storage and to estimate the changes that take place in the conversion of raw into par-boiled rice.

Rice Trade.

71. The phenomenal fall in the price of rice during the past few years led to a detailed enquiry about the conditions of production and marketing obtaining in the province. An officer was specially deputed for this purpose for a period of five months. His report was published recently indicating the lines in which improvements may be introduced.

Other Crops.

72. One of the methods to overcome the depression created by the fall in the price of rice was to grow more lucrative alternative crops in place of rice, wherever the conditions are favourable for the growth of such crops. Experiments to find out suitable crops to grow in place of or in rotation with rice were undertaken in the rice research stations. The cultivation of pine-apple in the proverbially poor *modan* lands of Malabar, where paddy is cultivated once in three years, has been found to be very profitable. At Pattambi it has been found that in a four year period there was a gain of nearly Rs. 250 per acre. In Maruteru, the cultivation of thin cane varieties like Co. 213 and Co. 218 in the place of thick canes which require to be expensively propped for protection against strong winds has opened up new possibilities.

(*d*) COTTON.

The Cotton Section.

73. Cotton is one of the most important of the industrial crops of South India. Five different varieties of cotton are being grown in this presidency. They are commercially known as Cocanadas, Northerns, Westerns, Salems, Tinnevellies and Cambodia. Much useful breeding work was being done on these for a long time by the several Deputy Directors of Agriculture and as a result, a number of economically useful strains were isolated. They were distributed on a large scale to the cultivators. As a result of the recommendations of MacKenna's Indian Cotton Committee of 1919, a post of Cotton Specialist was created in 1920 to work primarily on the improvement of Cambodia. A Cotton Breeding station was opened. The needs of other tracts continued to remain in the hands of the respective Deputy Directors who are however helped by special assistants trained in cotton breeding by the Cotton Specialist. The nature of improvements effected in the districts since the change in organization will be dealt with under the different circles. Improvement done by the Cotton Specialist himself are presented here.

Cambodia Cotton.

74. At the time of starting the section, the Cambodia strain that was holding ground was giving a yield of 650 lb. per acre. As a result of breeding work by the Cotton Specialist, two strains Co. 1 and Co. 2 were produced in 1924. Of these Co. 1 was found, after a few years of trial in the districts to be less robust though better in spinning quality than Co. 2 and was hence dropped. Efforts were then concentrated on the multiplication and spread of Co. 2. It has been uniformly reported for the past 10 years that on account of its introduction, the Cambodia yields have been increased by 15 per cent. No better proof of its popularity can be had than the fact that the department is not able to meet all the demands for seed supply even when Co. 2 seed is sold to-day at Rs. 5 per bag of 98 lb. when the local seeds are selling at Rs. 3–8–0 per bag.

Co. 2.

75. The cultivation of Co. 2 has spread over 75,000 acres in this presidency. Reckoning the increase at 15 per cent and the average yield at 750 lb. per acre, the extra income derived by the ryot on account of the cultivation of Co. 2 alone, leaving the increase in price obtained for the better quality—(Co. 2 has a staple length of 0·91 inch as against 0·85 inch of the locals)—out of consideration, works out at the current market rate to 10·5 lakhs of rupees per year. This amount will increase considerably as the area under Co. 2 increases every year as a result of further seed distribution, which has received an impetus by a grant from the Indian Central Cotton Committee (para. 300).

Better Strains.

76. Recently two more strains have been evolved. These have been observed to give 5 per cent more yield than Co. 2 and to be 10 days earlier and thus save one irrigation. Attempts are on foot to evolve still earlier types by hybridization. A few of the crosses between South African cottons and Co. 2 bid fair to yield crops that will mature one month earlier without any fall in the yield of *kapas*. These types, if found to breed true, will cut down the irrigation bill by 20 per cent.

Improvements through Agronomy.

77. Along-side these activities, the section is also exploring the possibilities of improvement by determining the optimum conditions for the growing of cotton. There is already one definite achievement to the credit of the section. By sowing the Cambodia cotton a month earlier, an increase of 30 per cent has been found to be possible; but the non-availability of irrigation water in certain places during September stands in the way of realizing the full benefits of this practice. It has also been found that, under Coimbatore conditions, irrigating Cambodia once in three weeks and manuring the previous crop rather than manuring cotton direct, lead to greater gain.

Schemes financed by the Indian Central Cotton Committee.

78. The Cotton Specialist is in addition in charge of four important schemes financed by the Indian Central Cotton Committee. None of these have run the full period of sanction and it is too early to comment on their achievements. Their aims may, however, be described as under.

The Pempheres and Physiological Scheme.

79. The objects of the Pempheres and Physiological Scheme are two-fold: (1) The evolution of Cambodia strains resistant to the attack of the stem weevil; a reduction of 20 to 25 per cent in yield results from the mortality due to an incidence of the stem weevil. (2) The evolution of a *Karunganni* strain which will shed the least number of buds and bolls during the untimely February rains; a fall of 50 to 60 per cent in yield may result on account of sudden rains falling during the early stages of boll development. The importance of these schemes will be better understood if it is realized that even a small increase in yield by controlling these two sources of loss would lead to enormous gain to the cotton grower.

The Nadam Scheme.

80. The *Nadam* Scheme has for its object the replacement of the perennial *Nadam* cotton of the Coimbatore and Salem districts by an annual type. Under the existing conditions of cultivation,

these cottons serve as convenient breeding grounds for the insects infesting cotton, and help to carry them over from year to year, leading to the deterioration in the quality of cotton.

The Fodder Cholam Scheme.

81. The Madras Fodder Cholam Scheme is intended to find out the causes of the lowering in the yield of cotton when it follows cholam in the rotation and to suggest suitable remedies. The loss due to this cause, has been estimated to be as much as 15 to 20 per cent of the total yield per acre.

The Herbaceum Scheme.

82. The Madras Herbaceum Scheme is the fourth scheme subsidized by the Indian Central Cotton Committee. In the tracts where Salems and Tinnevellies are grown, the short stapled *Uppam* is being grown as a mixture with *Karunganni* a cotton of fine quality, with the result that the cultivators fail to get the full benefits of growing cottons of high spinning value; but *Uppam* has certain agricultural characters in its favour. Attempts have, therefore, been made to evolve a strain which will combine the good qualities of both the varieties. Seven years of work in selection had proved of no avail. When crossing was taken up, the efforts would appear to have borne fruit. There are now available three strains which yield as much as *Karunganni* and withstand drought as well as *Uppam* does.

Red and Bengal Grams.

83. Apart from cotton, the section is also attending to the improvement of red and Bengal grams, pulses grown extensively in this presidency. In the latter crop, four strains have already been evolved and are in the multiplication stage. These are found to give 15 to 20 per cent more yield and to be more resistant to the wilt disease than the local variety. In the red gram, the South Indian varieties have been crossed with the earlier and better cooking types of Northern India. Some of their progenies are able to mature within four months. It may be of interest to point out here that more than 150 lakhs of rupees worth of grams were imported in 1934 into this province.

(*e*) Millets.

The Food Crops of the Poor.

84. A section for work on millets was started at the end of 1921 for the improvement of such food crops of the poor as *Cholam*, *Cumbu*, *Ragi*, *Korra*, *Arika*, *Samai*, *Variga*, and *Kudiraivali*. For working on these crops a Millets Breeding Station was started at the end of 1923 at Coimbatore.

Knowledge on Millets.

85. Millets are not commercial crops. Much work has not been done on these. There is, therefore, not much of previous literature on them. Their study had to begin practically new. At the Millets Breeding Station these crops have been studied both as individuals and as populations. Unit characters and their mode of inheritance have been studied, and over fifty scientific articles on these aspects of the crop have been published during the last ten years. The contribution of this section to this fundamental knowledge so very necessary for a successful improvement of these crops has been substantial.

Organization.

86. Armed with this knowledge, the improvement of the yield of the millets has been in progress. Being crops grown under rain-fed conditions and being susceptible in an extreme degree to local climatic and soil factors, the improvement of these millets for the whole presidency from a central institution was realized to be not a practical proposition. Therefore millets assistants trained at the central breeding station were posted to the Hagari and the Nandyal Agricultural Research Stations in the year 1931, and to the Guntur and the Kovilpatti Agricultural Research Stations in the year 1932, for carrying on selection and improvement work on the millets of the Bellary, Kurnool, Guntur and Tinnevelly areas of the presidency.

Dry Farming.

87. Millets being, in the main, crops grown under dry farming conditions, intensive research both on the plant and on the soil with reference to climatic and other environmental factors was considered a necessity and to meet the requirements of research in this direction, a collaborative scheme of Dry Farming Research financed by the Imperial Council of Agricultural Research was drawn up and inaugurated at Hagari in the Bellary district. The Senior Assistant of the millets section is the Superintendent of the scheme and other assistants trained in millets are working with him.

Jonna—Tel. Cholam—Tam.

88. *Jonna* or *cholam* is the Great Millet. It is the premier cereal for dry lands. It yields good grain and valuable fodder and is thus suited for both man and beast. Its distribution is world-wide, large areas in Africa and America being under it. Its grains are naked and present great difficulties in preservation. A survey of the sorghums of this presidency was undertaken and the collection made was augmented by Indian varieties outside Madras. Advantage was taken of the work on the classification of sorghums undertaken at Kew in England to establish a contact with that centre of work. A large African collection has thus been made available with a wealth of material suitable for hybridization with local varieties.

Sorghum flowers at midnight, and the technique of crossing its tiny flowers presents peculiar difficulties. Intense breeding work throwing light on the inheritance of its many complex characters is in progress. Work correlating certain plant characters with yield has furnished much information of practical importance. Apart from the work done at Hagari, Nandyal, Guntur and Kovilpatti, which will be recorded by the respective Deputy Directors, the chief economic work has been to cater to the areas in the neighbourhood of Coimbatore. Irrigated strains of sorghum have been the first to be given out in the districts. A white sorghum strain, A.S. 367, has done well in the Chittoor area. Another, A.S. 2095, bids fair to excel it. A.S. 1575, another white sorghum strain, has done well in the Coimbatore and Salem areas. A.S. 809, an yellow irrigated variety, is doing well round about Coimbatore. A.S. 841, a red sorghum, has just been given for trial in the Salem area. Of rain-fed varieties, A.S. 29 and A.S. 1098, are the strains given out in *Peria Manjal cholam*. Endeavours are in progress to improve the quality of the straw of both *Peria Manjal* and *Talai Virichan* varieties.

Malt.

89. A commercial backing will give a great impetus to the improvement of sorghum. The largest possibility lies in the direction of malt making. Many varieties suitable for this purpose are being continually passed on to the Agricultural Chemist for malt tests. Suitable varieties are multiplied for large scale trials.

Sajja—Tel. Cumbu—Tam.

90. *Cumbu* is the second important millet in the presidency. It is a quick grower and thrives in sandy loams and in areas of light rainfall. Its habit fits it to tide over the vicissitudes of the weather. It is protogynous, viz., the female elements in the flower are ready for fertilization before the male elements in the same flower are ready to fertilize. This results in extensive cross-fertilization. It is, therefore, difficult to keep an improved strain pure. A second disability is the nakedness of the grain which is not enclosed by the husk. A peculiarity of this millet is its habit of flowering throughout the day and the night, with a concentration at midnight. These points will bring home the difficulties attendant on work on this crop. Even so, after a study of many presidency varieties, suitable ones for dry and irrigated lands have been isolated. Of these M.S. (P.T.) 2229, a selection from *Kottappuli cumbu* has just been given out to the cultivators.

Ragi.

91. Being a garden crop *ragi* has not received any set back in the work on it which its sister millets grown under rain-fed conditions are liable to. All the varieties in the presidency have been gathered and are under study. Hundreds of single plant selections have

been under study and the most promising among them put to comparative trials for yield. A strain, E.C. 593, proved to be the best *ragi* at the station. Its trial at other places in the Coimbatore, Salem, Trichinopoly, Chittoor, Vellore and South Arcot districts was equally successful and so far the primary distribution of seed from the central station amounts to over 12,000 lb. This excludes the natural spread of this strain after the first introduction at each centre. Another strain, E.C. 3030, about ten days shorter in duration that E.C. 593, is ready to be distributed in areas where *ragi* of a shorter duration is needed.

Korra—Tel. Tenai—Tam.

92. This small Italian millet is a very useful food crop in areas where cotton is prominent. Its quick growth makes it specially useful to figure as a mixture with cotton. A strain, S.I. 523, suitable to red loams under rain-fed conditions has been evolved and has begun to spread.

Minor Millets.

93. As work on the four millets referred to above advances a little more, the present reconnaissance stage of the work on the other minor millets like *Arika, Samai, Panivaragu* and *Kudiraivali*, will get intensified.

(*f*) OIL-SEEDS.

Oil-seeds Section.

94. Oil-seed crops occupy over 15 per cent of the area cultivated in this presidency. Groundnut, gingelly, castor, and the perennial palm, coconut, are the chief oil-seed crops. There is a large volume of export trade in these oil-seeds from our presidency. Realizing the importance of the large area and the monetary value of these crops, a special section devoted to oil-seeds was started in 1930 with the object of improving the yield and increasing the oil content of the oil-seeds.

Groundnut.

95. The area under groundnut crop 3·3 million acres and is well over 9 per cent of the total area sown. Over hundred varieties of groundnut, mostly imported, have been acclimatized and tested for their yield of seed and oil. As a result of this investigation, a variety—Saloum—from West Africa was found to yield 20 per cent more than *Local Mauritius*. About 6,000 lb. of seed of this variety have been distributed during the years 1933 and 1934. This variety has done well in the districts of South and North Arcots, Chittoor, Salem, Guntur and Trichinopoly. It is also found to be drought resistant, a distinct advantage to its spread in districts with low rainfall.

As Indian groundnuts have now to face much competition from West Africa, it is desirable to improve the quality of our groundnuts which have been subjected to much adverse criticism by European importers. From the point of view of quality, groundnuts must contain more oil and less free fatty acid. Our groundnuts often contain more free fatty acid than those from other countries. From a thorough investigation it is found that the seeds are not defective, but that early harvest, wet storage of the produce and wetting of the groundnut for shelling are responsible for the deterioration in quality.

For the proper utilization of the varieties in selection and breeding of improved types, a comprehensive study of the plant during its various phases of growth is necessary. The study of the root system, branching, flowering, and the inheritance of the different characters of the plant has progressed considerably and much fresh light has been shed on this crop. With a view to introduce vigour through wild blood in the cultivated groundnuts, two wild Brazilian species of the groundnut have been crossed with the commonly cultivated varieties and the results are awaited with interest.

Coconut.

96. The graceful coconut palm which adorns South India covers about 551,000 acres in our presidency and furnishes raw products for many of our well-established industries. Everyone is aware of the simple fact that good crops can be raised by manuring and watering, but it rarely strikes one that inter-cultivation is also of great importance in unirrigated coconut gardens. By ploughing two to three times in the year and working the *guntaka* or any other cultivating implement three or four times in the hot months, yields can be easily doubled. The vagaries of the season have less effect on the trees in a garden that is cultivated than on those in a plot left uncultivated. Cultivation thus results not only in higher yields but also in a steadier income. Inter-cultivation is found to be more important than the system of manuring commonly practised by the cultivators. It is interesting to note that the yields of coconuts steadily rose from 35 to over 70 nuts per tree per annum in a period of 16 years under the departmental system of cultivation. If one cultivates and manures his trees regularly he will normally make a profit in a garden with a normal stand of 50 trees per acre, even when the price is as low as Rs. 20 per 1,000 nuts. It is found most profitable to raise a crop of green manure before the monsoon sets in in June and to plough it in August. In addition to this the best manure is a mixture of 20 pounds of ashes and 3 pounds of ammonium sulphate per tree, though ashes alone are good enough.

During the twelve years ending with 1933, 61,000 selected coconut seedlings and 28,000 selected seed nuts were supplied to the cultivators from the coconut stations. But since it is most desirable that seed nuts and seedlings should be locally selected by the cultivators themselves, an enquiry into the characteristics which distinguish good seed parents and good seedlings was undertaken. It

was found that the seed nuts should be selected from parent trees having a large number of leaves and producing medium sized round nuts. In the nursery, the seedlings from the nuts which had germinated early should be selected. When these principles are followed in selecting the nuts and seedlings, the palms should bear nuts early and profusely. The breeding work on this perennial palm has commenced in earnest.

Copra.

97. About *copra* it has been found that the bigger the size of the husked nut, the larger is the output of *copra* from it. When the nuts are harvested after twelve months' maturity the largest amount of *copra* and oil are obtained. The nuts harvested in the period March to July contain more *copra* than the nuts harvested in other periods. Among the medium sized nuts, round nuts contain more *copra* than the oval or long nuts. Storage of nuts for about a month after harvest will give 5 per cent more *copra.*

Other Oil-seeds.

98. About 782,000 acres are sown with gingelly. Over 80 varieties of this crop have been collected and a number of selections have been obtained. Numerous crosses have been made to combine their desirable characteristics.

Castor occupies about 312,000 acres. Sixty varieties have been gathered. Vigorous and high yielding lines are being purified, and these will be tried in the districts in a few years.

A cashewnut plantation is being grown for detailed investigation of this crop. The West African oil palm and the date palm are being tried for their suitability to the West Coast. The suitability of soyabeans to different tracts is under investigation. The method of manufacturing starch from tapioca, on a cottage industry scale, has been demonstrated.

Long range Research.

99. How often do the passers-by wonder when they see an officer counting the leaves of a plant or manipulating the flowers with the aid of a lantern early in the morning or late in the night? The man in the street is sceptical about the importance of counting the flowers or observing them when they open. And yet these investigations and many others of the same type are as important as the solutions of problems themselves, for these investigations ultimately lead to the solutions with which the man in the street may be acquainted. Why do the roots of the coconut reach the depth of 25 feet and spread about up to 40 feet? Why do the plants of some varieties flower earlier? Why are the female flowers of the coconut —popularly known as "buttons"—shed? Why do the flowers of

gingelly turn into "leaves" in some seasons? How do the characters of plants behave from one generation to another? Problems like these of which no account is given here, engage the constant attention of the staff.

(g) SUGARCANE.

Sugarcane Improvement.

100. Sugarcane is a valuable crop. It is one of the few crops that provide work for its grower and his family throughout the year. Being a commercial crop it provides the cultivator the necessary cash with which he can buy manure and fertilize his fields liberally. The tops of canes provide valuable fodder for cattle. The importance of sugarcane growing was recognized long ago and a special "Indian Sugar Committee" was appointed in 1920 to go into the question of the improvement of the sugarcane and of the sugar industry in general. With reference to Madras, the Committee recommended the establishment of a Sugarcane Research Station for the Ganjam and Vizagapatam districts and a second station in the Chittoor area. In 1922 the Government examined the recommendations of the Indian Sugar Committee and deputed an officer of the Agricultural Department to make a preliminary examination of areas in the northern districts of the presidency, more especially in the Agency tracts which might prove suitable for the cultivation of sugarcane and for the installation of sugar factories. Advantage was taken of the encouragement afforded by the Imperial Council of Agricultural Research, to formulate a scheme for the augmentation of the staff at the Agricultural Research Station, Anakapalle, the starting of a second centre for research in sugarcane at Gudiyattam in the Chittoor area, and the placing of both these centres of research under an officer wholly devoted to research on sugarcane for the benefit of the presidency. In spite of the importance and economic value of sugarcane the extension of the area under it has not been rapid. An examination of the causes led to the need for improvements in the following directions, likely to react favourably on its acreage. The improvements that could be effected are under the five following heads :—(1) Seed, (2) Irrigation, (3) Manuring (4) After-cultivation, and (5) Harvest and manufacture.

Short Crop.

101. In some parts of the presidency the expenditure on sugarcane setts for planting is high. A portion of the previous crop is generally utilized for this purpose. In places where crushing and planting synchronize, the tops of the cane are used for planting. The planting can also be done at a later date, if the tops are preserved carefully. The main principle involved is the planting of immature cane to ensure good germination. Immature cane setts being thus desirable, it was thought necessary to produce immature cane by raising a special short crop. At Anakapalle the seed cane

is planted early in February and given liberal manures and irrigations. No proppings or wrappings are done to the canes in this crop. The growth is ordinarily very satisfactory and by the middle of August or the beginning of September the crop can be cut and used for planting. It is desirable to raise this seed crop on garden lands. In places where such facilities do not exist, the short crop can be raised in wet lands on elevated beds. Experiments made in the four years 1924 to 1928 prove that the crop from the mature seeds gave an average yield of 20·27 *candies* of 500 lb. each as against 23·52 *candies* of jaggery from the crop raised from short crop seed. This is an increase of 16 per cent and proves the profitableness of this improved method of meeting the seed supply. This method is followed by many cane growers in Vizagapatam.

Less Irrigation.

102. Want of irrigation facilities is partly responsible for the restriction of the area under sugarcane. A study of sugarcane varieties shows that some varieties have a shallow root system, e.g., B. 208, Fiji B, and Purple Mauritius. Their roots go down to a depth of about 3 feet only and they therefore require frequent irrigations. There are varieties like Co. 213, Co. 243 and Co. 281 whose roots penetrate to a depth of about 6 feet on account of which they do not suffer under restricted water supply. At the Anakapalle Station, Co. 213 was grown along with J. 247 with only one irrigation at the time of planting. The results of six years of comparison show that Co. 213 gives an average increase of 40 per cent in yield over J. 247. It is also found possible to try Co. 213 as a pure rain-fed crop. This adaptability is responsible for its rapid spread in the Kistna delta and the consequent starting of a sugar factory in that area.

Manuring.

103. It has been ascertained that a crop of 30 tons of sugarcane from an acre, removes from the soil about 80 pounds of nitrogen, 50 pounds of phosphoric acid and 180 pounds of potash. Indian soils are generally deficient in nitrogen, and this has to be made up through manures. It has been found that a mixture of organic manures like oil-cakes, and inorganic fertilizers like ammonium sulphate, is the best manure for sugarcane. Phosphoric acid may be added as super-phosphate directly to the cane crop or as bonemeal to the previous cereal crop. It has been ascertained that cane varieties differ in their manurial requirements. J. 247 which occupies a large area has been found to respond favourably to a manuring of 1,000 pounds of groundnut cake, and 2,000 pounds of wild indigo leaves. This dose was not sufficient to bring out the best from another variety, namely, B. 208. In the case of the hardy hybrid Co. 213 the same dose of manure was found to be too high; there was in fact a tendency to do harm by lowering the sucrose content and purity ratio. With a judicious system of rotation it has been found that 100 pounds of nitrogen was sufficient at Anakapalle, the

rotation followed being sugarcane, first year; sunnhemp for green manure and paddy thereafter, second year; early *ragi* and paddy preparatory to cane, third year; paddy and *ragi* receiving no manure.

Cultural Improvements.

104. Weeding, wrapping, propping, trenching, and other similar operations contribute to the cost of cultivation. Inter-cultivation with implements like junior hoe, H.M. *Guntaka* or the country plough saves expenditure on cultural operations. Varieties like Co. 213 do not ordinarily require any propping and wrapping. Rs. 100 to Rs. 150 is usually spent on these items and a considerable saving can thus be effected by the judicious introduction of suitable canes that do not need these costly attentions.

Manufacture.

105. The introduction of improved furnaces like the *Godavary* and *Sindhewahi* furnaces economize the fuel bill. The preparation of white sugar by the open pan system in preference to converting the crop into *gur* or jaggery, has given indication of a gain of at least Rs. 100 per acre to the cultivator.

How an all-round improvement in the many ways indicated above will re-act in reducing the cost of cultivation considerably will be evident from the working of costs of growing the old variety J. 247 in the old methods as compared with the economics of growing the new variety Co. 213 with modern improvements. Calculations made from the figures available at Anakapalle prove that such costs can be brought down by as much as two-thirds. Whether so much saving can become universal is not attempted to be indicated. But the importance of the general effect of varietal and agronomic improvement on the economics of cane-growing is patent.

Further Research.

106. The present intensification of work on sugarcane research has for its aim an all-round attack on the problem of the sugar industry. Attention is bestowed on canes to suit restricted irrigation and manure and canes that could have good irrigation and the standard dose of manure. Such points as the germination capacity of setts, root development, resistance to drought and water-logging, shoot development and habit, vigour at growth, flowering propensities, duration, thickness of cane, and susceptibility to diseases and pests are demanding intense attention. Manurial trials are in progress to find out the optimum doses for different varieties. This includes the trial of molasses as manure. In cultural experiments various degrees of restriction in irrigation are under trial. The effect of swampy and ill-drained conditions are under study. Ratooning and its effects are being observed. Trials of setts and seedlings in dry lands are in progress. The effect of different spacings in relation to irrigation and manuring are in the

programme of studies. The foundations for research in this important crop full of industrial promise have thus been well and truly laid.

(*h*) HORTICULTURE AND POMOLOGY.

Horticulture.

107. There are two gardens on the Nilgiris, (1) the Government Botanical Gardens, Ootacamund, and (2) Sim's Park, Coonoor. These are maintained as public pleasure resorts and for the purpose of carrying out horticultural research. They are of great botanical value, and botanists and horticulturists from all parts of the world visit them. Large nurseries are attached to the Botanical Gardens, including a number of glass-houses in which are raised plants for furnishing the two conservatories, and they also house the collections of orchids and succulent plants of which there are fairly a representative number of species and genera. In these nurseries and at the one at Sim's Park thousands of plants are stocked for distribution to the public. These gardens are responsible for the introduction and distribution of many kinds of ornamental plants, vegetables, fodder plants, useful timber trees and also various medicinal plants. The Botanical Gardens and Sim's Park are very popular resorts which during the 'season' are crowded with visitors from the plains.

The Pomological Station, Coonoor.

108. There are three Fruit Research Stations on the Nilgiris, (1) The Pomological Station, Coonoor, (2) Burliar Experiment Fruit Station, and (3) Kallar Experimental Fruit Station. The Coonoor Station was established in 1920 and now covers an area of approximately 12 acres. It is planted up with many kinds of subtropical and temperate fruit trees such as apple, pear, plum, peach, quince, persimmon, cherimoyer, loquat, fig, orange, grape-fruit and lemon. Of the many varieties of apples and plums under trial the following are producing fair to good crops :—Apple—Rome Beauty, Winterstein, Irish Peach, Allsop's Early and Zouches' Pippin; Plum—Hale, Rubio, Shiro, Kelsey, Wright's Late and Alu Bokara. Orange, quince, persimmon and Keiffer pears are also fruiting well, and the grape-fruits more recently planted are showing signs of great promise.

Considerable attention has of late been paid to the testing of the different stocks for grafting purposes as these have a considerable influence on the growth and fruitfulness of the trees. As an instance, it has been discovered that the pear unites readily and grows freely when grafted on to apple stocks; but it will be some years before it is known whether the trees will come into bearing earlier and fruit more freely than when grafted on to the pear. Until recently the apple was grafted only on to locally produced

crab apple stocks, but a few years ago three selected varieties of stocks were imported from East Malling in England where a considerable amount of research has been undertaken, and these are being tried out at the station and the propagation of these stocks expedited.

As regards the propagation of citrus much difficulty has been experienced, and after a considerable amount of research, budding has been discontinued and grafting by the 'approach' method resorted to as being the most suitable to local conditions.

The propagation and distribution of the various fruit trees growing at the station have received considerable attention, and many hundreds of grafted fruit trees and seedlings are distributed from the station annually.

Burliar Fruit Station.

109. The Burliar Fruit Station is situated on the Coonoor Ghat at an elevation of about 2,500 feet above sea level. Here are grown many kinds of tropical fruits and spices, such as the mangosteen durian, orange, grape-fruit, langsat, litchi, avocado, clove, nutmeg cinnamon and all spice. Since 1920 special attention has been paid to the propagation and culture of the mangosteen, which had hitherto presented some difficulty, and had, in consequence, prevented the extension of this valuable fruit tree under cultivation. In 1927 seventy-five young trees were planted out in the station, some of which are reaching the fruiting stage. Records of their rate of growth and other particulars are being maintained, so that the history of each tree will be known and the best trees selected for propagation purposes. Experiments are being tried also to speed up the propagation of the mangosteen by grafting it on to other and more vigorous species of the same family.

At this station a nursery is maintained in which are stocked many young fruit and spice seedlings, of which hundreds are distributed annually to intending growers in different parts of the presidency, and sometimes even to other parts of India.

Kallar Fruit Station.

110. The Kallar Fruit Station is located at the foot of the Coonoor Ghat at an elevation of about 1,400 feet above sea level. It was formerly used for experiments in rubber cultivation, but since 1920 most of the rubber trees have been uprooted and the land utilized for the experimental cultivation of tropical fruit trees. The most important fruit tree under trial at this garden is the mangosteen of which there are 75 young trees. These were planted between 1924 and 1926, and are growing very well. Some of the trees have reached a height of over 12 feet and are beginning to bear fruit.

The grape-fruit is also being cultivated on a fairly large scale, as are the different varieties of orange, mango, sapota, and pine-apple. Manurial trial plots for pine-apple have been laid down to determine the manurial requirements of this important fruit plant. At this station are grown on a smaller scale such trees of economic value as the cocoa, Kola nut and Queensland nut, and such fruit trees as litchi, pomegranate, grape-vine, custard apple, Surinam cherry and rambutan, the last being a recent introduction from Ceylon.

Among other recent introductions under trial are two new varieties of pomegranate received from the Kew Gardens in 1933. The plants were obtained by Kew with considerable difficulty from Persia through a Plant Collection Expedition which toured that country. Young plants have already been raised, and these will be distributed to other agricultural stations in the presidency in the near future.

Diospyros mollc, the source of a valuable black dye, introduced from Kew in 1932, is growing well, some of the trees having attained a height of 24 feet.

The nursery attached to this station is a fairly large one, and is well stocked with numerous grafted fruit trees and fruit seedlings, the more important being sapota grafts, for which there is an increasing demand from different parts of the presidency. The demand for other fruit plants is also considerable and many hundreds are distributed yearly from this station.

A catalogue of fruit trees and ornamental plants available for distribution from these gardens can be had from the Curator, Government Botanical Gardens, Ootacamund, on payment of annas four.

The Fruits of the Plains.

111. Although fruit growing in the plains has been practised from time immemorial, it is only very recently that it has begun to make an appeal to the rural classes in this presidency as a commercial industry. The phenomenal success achieved in the development of fruit industry in other parts of the world and the recently accumulated scientific evidence on the valuable dietetic qualities of fruits combined with the general post-war depression in the price of the agricultural produce, have been to a large extent responsible for inducing the agricultural classes to take up commercial fruit growing in right earnest. The few pioneer attempts that have been made here and there in the presidency have stimulated this desire by demonstrating the fact that fruit growing, if carried on properly, is one of the most paying agricultural professions. In recent years, it has been the good fortune of some of the fruit growers of Kodur (Cuddapah district) to get an annual income of over a thousand rupees per acre from citrus growing. Such huge profits have, no doubt, served as an incentive for the rapid extension of acreage under this fruit in several parts of this presidency.

The Fruit Research Station, Anantarajupet.

112. The Government of Madras have fully realized the importance of giving an impetus to this industry for a long time past. Thanks to the Imperial Council of Agricultural Research, who generously made a grant of about Rs. 66,000 spread over a period of five years, the Government of Madras have now been able to give a practical shape to its desire of furthering the industry by the starting of the Anantarajupet Fruit Research Station, in the centre of an important citrus belt of this presidency. The Madras Government provided funds for the acquisition of about 50 acres of land. In addition to the Superintendent it has a staff consisting of a Farm Manager, two probationers under training and a Fieldman. The research work of the station commenced in the beginning of August 1935 when the Superintendent took over charge of the station. The aim of the station is to tackle in due course problems involving all aspects of fruit growing.

Problems of the Fruit Industry.

113. Among the major problems to be dealt with are, the introduction and trial of almost all the varieties of citrus and other fruit trees of proved merit and of acknowledged importance in the fruit trade, with a view to find out the most suitable and commercially profitable ones to the region. Side by side, it is proposed to take up a comprehensive scheme of experiments on the cheapest and most convenient methods of raising trees, with the ultimate object of stocking our gardens with healthy, vigorous, precocious and most productive trees, budded or grafted as the case may be on the most desirable stocks. Every fruit grower realizes the very great importance of this work; for, the selection of stocks and the method of propagation make all the difference between failure and success in the case of perennial crops like fruits, particularly because of the fact that the result of the defective nursery practices would become evident only six to eight years after planting. Besides these, it is well known that there are other problems like cultivation, manuring, irrigation and disease and pest control of fruit trees with which the fruit growers at present are almost entirely in the dark, as is evidenced by the marked variation in the orchard practices from place to place. The research station aims at the standardization of such practices, and imparting knowledge of practical value in all these various aspects of fruit culture.

There is another aspect in which the fruit growers are at present greatly handicapped and that is the purchase of reliable nursery plants. Without dilating much upon this important phase it may however be stated that the failure of many gardens all over the presidency is in a large measure due to the planting of useless trees of unknown parentage, sometimes supplied even under wrong names. The research station wishes to solve this difficulty by arranging to supply, if possible, reliable plants of known parentage propagated from trees of proved merit.

These problems are also intimately connected with the proper nomenclature and classification of fruits—a subject on which there exists at present very great confusion and which therefore needs to be dealt with exhaustively.

(*i*) MYCOLOGY.

Fungoid Diseases.

114. The Mycology section deals with diseases of crops caused by fungi. The annual losses incurred by the South Indian cultivator on account of diseases such as *cholam* smut, paddy blast and red-rot of sugarcane amount to millions of rupees, and the need to combat such diseases is obvious. In order that the remedial measures suggested may be economical and effective, it is essential that the diseases are diagnosed in the early stages, and the disease causing agent is attacked in its most vulnerable point. This is done either by applying a cheap fungicide to destroy the organism without injuring the crop plant, or making the environmental conditions unfavourable for the development of the disease. It is also sometimes found necessary to destroy the affected plant itself in order that the disease may not spread to other plants. All these involve an intimate knowledge of the life history of the disease-causing organisms and the way they attack crop plants. The work of the Mycology section therefore consists in the study of fungi and other organisms with a view to the control of plant diseases. The section has done much in this direction and an account of the progress achieved with regard to a few of the important diseases is given below.

Palmyra Bud-rot.

115. The bud-rot diseases of palms caused by a fungus known as *Phytophthora palmivora* was first investigated in 1906. It was found to be responsible for the death of a large number of trees in the Godavari and Kistna deltas, and the rapidity with which it spread from one area to another called for drastic measures. Accordingly the " Agricultural Pests and Diseases Act " was passed and the application of this in the Godavari, Kistna and Malabar districts has resulted in checking the progress of the disease. A similar disease of coconuts has also been checked by adopting suitable remedial measures in time.

Arecanut—Mahali and Stem-bleeding.

116. In the West Coast the *mahali* or *koleroga* disease of arecanuts was found causing severe damage to the crop. During the monsoon this disease causes the young fruits to rot on the bunches and drop down. It was found that the disease could be checked by spraying with Bordeaux mixture (paragraph 129). In most of the gardens where spraying was done for several years, the disease either did not appear or the attack was mild. The spraying is done

by means of a small spraying machine costing about Rs. 25.* The cost of spraying the bunches of 100 trees is about Re. 1. This is insignificant when compared to the gain from the crop saved. The arecanut growers are fully convinced of the efficacy of this treatment and they are doing it as a regular agricultural practice. The necessary ingredients (copper sulphate and lime) for the preparation of the mixture are now sold in convenient packets in the bazaars of the localities along with instructions for their use. The stem-bleeding disease is another disease of the arecanut. This disease is recognized by the red viscous fluid oozing out from the cracks of the stem of the tree. The affected trees gradually lose their condition and die. The remedy consists in removing with a chisel all the diseased tissue and applying hot tar to the wound thus caused.

Paddy Diseases.

117. Considerable work has been done on two important diseases of paddy, viz., blast and foot-rot. These two diseases have been found to be responsible for a good deal of damage to the crop in the presidency, the former in the Tanjore and the latter in the Godavari area. The blast disease of paddy is caused by a fungus *Piricularia oryzae* and is difficult to control by the ordinary fungicidal methods. Work was therefore directed towards finding out disease-resistant varieties, and strains G.E.B. 24, Co. 1 and Co. 4 have been found to be highly resistant. With regard to the control of the foot-rot disease it has been found by a close study of the disease that the best method of control is the treatment of seed before sowing with a fungicide known as Ceresan. The infective spores which adhere to the seed are thereby killed and the crop is saved from the disease.

Sugarcane Red-rot.

118. Three major diseases of cane have been studied and measures to combat them have been popularized among the cultivators. Of these diseases red-rot is the most serious. The loss due to this disease is enormous. But the department has considerably reduced this loss in recent years by carrying on a vigorous propaganda for the selection of disease-free setts and the introduction of new varieties, with the resultant increase in the output of cane, as well as the improved quality of the produce. Except in isolated instances, the disease could be said to have been kept under complete control.

Sugarcane Mosaic.

119. The danger of loss in the case of the sugarcane mosaic disease is not so apparent to the cultivator as in the case of red-rot, but the danger is none the less real as in course of years the cumulative effect of repeatedly growing diseased setts brings about a condition in which the entire crop may be lost. As the name implies the disease is characterized by a peculiar mottling of the leaves. From a distance a badly diseased field shows a yellowish instead of

the healthy dark green colour. On close examination the discolouration is found to be due to innumerable whitish or at times yellowish blotches on the leaf surface. These blotches are elongated and possess wavy margins. The pale areas alternating with the normal green form a distinctive pattern, the details of which vary with the variety. For instance in Java-Hebbal and *vellai* the normal dark green colour appears as a few irregular islands on a pale green back ground. On the other hand in the varieties *poovan* and Co. 1 the green colour forms a back ground for irregular white blotches. As a rule the disease is found on the leaves. In some cases the mottling tends to become obscured with the age of the leaf so that it is difficult to detect it in the older leaves. The symptoms of the disease are therefore unmistakably found on the youngest leaves of the shoot and they are invariably visible as soon as the leaves unfold. In some varieties of cane a kind of mottled appearance caused by other causes than the mosaic disease is found confined to the old lower leaves, while the young leaves are quite free so that one has to depend on the examination of the spindle to satisfy one-self that it is not a case of mosaic. The disease is also to be differentiated from entire chlorosis of the leaves where the whole leaf turns white or yellow, and from partial chlorosis where yellow stripes run along the whole length of the leaf. The disease however may be kept in check by (i) growing disease resistant varieties, (ii) careful selection of setts, (iii) roguing out diseased plants as soon as they are noticed in the field. The department has placed a number of new varieties before the cultivators from which they can choose varieties suitable to their tracts.

Sugarcane Smut.

120. The smut of sugarcane is another disease which by the application of common sense methods, viz., prompt removal and destruction of the affected shoots, has been kept under control in a number of places where otherwise it would have assumed serious proportions and caused considerable havoc. The disease is manifested in the central shoot being converted into a whip-like appendage filled with a mass of fungal spores. As soon as the external symptoms of infection are noticed in the plant, it is necessary that the plant is at once removed and placed in a close textured cloth bag and immersed in boiling water. This is done in order that the spores of the fungus may not get distributed during the act of collecting and transporting the diseased material. By adopting this simple method, the disease has been successfully brought under control in the cane farm at Nellikuppam belonging to Messrs. Parry & Co., and in other cane areas of the South Arcot and Chittoor districts.

Smut on Cholam and Tenai.

121. The smut of *cholam* and *tenai* is another disease which has been successfully controlled by preventive measures. The disease is caused by the spores of the fungus which adhere to the seed.

The treatment for controlling this disease consists in steeping the seed for sowing in copper sulphate solution or mixing it with fine sulphur powder. The cost of treatment is low being about 4 pies per acre in the case of copper sulphate and a little over 1 pie in the case of sulphur and it has become very popular with the cultivators. Thousands of acres in the Ceded districts and in other *cholam* growing areas are now sown with treated seeds and the loss is thus considerably minimized.

Grape-vine—Mildew.

122. The disease known as 'mildew' on grapes has been checked successfully in the villages in the Madura district. The value of the crop from vines sprayed with Bordeaux mixture was many times more than that of the unsprayed vines. Convinced of the efficacy of spraying, the vine growers, have taken to it and some of them have even purchased machines of their own and use chemicals purchased by themselves. The cost of treatment for an acre is about Rs. 75 for three sprayings.

Betel vine—Phytophthora.

123. The *Phytophthora* disease of betel vine is prevalent in the Chingleput district. This causes the plants to wilt and die. At Poonamalle, in the Chingleput district, control measures were tried by spraying the bottom portion of the vines with Bordeaux mixture and also by soaking the soil around the vines with the same mixture. Suitable rotation of crops and maintenance of good drainage have a very good effect in reducing the disease.

Tobacco Wilt.

124. The investigation of tobacco wilt which was taken up recently has already yielded fruitful results. The disease is prevalent in the Salem district and causes considerable damage to the crop. It has been found by experiment and confirmed by later experience that systematic spraying of the nursery and the transplanted crop with Bordeaux mixture and disinfection of seed beds by burning trash on the surface, are very effective in combating the disease.

Other Activities.

125. Besides the above, considerable progress has been attained in the investigation of many other diseases of crops as for example, wilt of plantain, boll-rot, wilt, and seedling blight of cotton, wilt diseases of pulses and oil-seed crops and the diseases of citrus and other orchard trees. Attempts have been made to assess the susceptibility of a number of varieties in each crop with regard to their specific diseases.

General Remedial Measures.

126. In all cases where remedial measures are attempted, care is taken to see that they are practicable and within the means of the poorest ryot. The methods advocated may be summed up as follows :—(1) Selection of clean and healthy seed for planting. (2) Removal of infective material from the fields and maintenance of sanitary conditions in them. (3) Application of fungicides. (4) Introduction of disease resistant varieties.

Bordeaux Mixture.

127. It will be noticed that among the many remedies against fungus diseases, spraying with Bordeaux mixture is the commonest. The following hints will be helpful in the preparation of one per cent strength of the mixture. Take 5 lb. of copper-sulphate, 5 lb. of quick lime, and 50 gallons of water. Dissolve the copper-sulphate in 25 gallons of water in a wooden, earthenware or copper vessel. Place the quick lime in another vessel by sprinkling some water over it and add more water till a creamy paste free from lumps is formed. Add the remaining water to the lime and stir well. Slowly strain this milk of lime into the copper-sulphate solution stirring the mixture well all the time. To test the mixture, dip a polished knife blade or other piece of iron into the mixture for about a minute. If the blade shows a reddish deposit of copper, add more lime till the clean blade is not stained when dipped afresh in the mixture.

(*j*) ENTOMOLOGY.

Aims.

128. It is a well known fact that a cultivator loses a fair portion of the yield of his crop due to insects damaging the crop in various stages. In the Madras Presidency, losses to the crop in the field and the produce in storage are roughly computed at about 200 millions of rupees per year. To reduce and, if possible, to prevent such colossal losses has been the aim of the Entomological section.

Knowledge is Power.

129. A study of insect pests is most essential in devising ways and means of controlling them. It is not often that the desired knowledge is obtained within a short space of time. Experiments will have to be carefully planned and spread over a number of years if useful results are to be obtained. Hence the need for patient research. Once suitable remedial measures are evolved this knowledge could be made available to the ryots. The following are some of the major pests of crops for which successful control methods have been evolved.

The Swarming Caterpillar of Paddy.

130. The swarming caterpillar is one of the most serious pests of paddy as it usually appears suddenly and in enormous numbers, and wipes out entire fields within a short time. Generally there is no sort of warning whatever of an outbreak and so, if proper measures are not taken instantly and in time, it may not be possible to save the crop. As a result of careful studies it has been found that flooding the infested fields, if there are facilities for irrigation, is very effective against the pest. In places where water is not available, especially where nurseries are concerned, dusting with calcium arsenate diluted with twice its volume of slaked lime has been found to be very effective.

The Paddy Stem Borer.

131. A special sub-station was opened to pursue the stem borer pest of paddy at the Samalkota Research Station. It was found that the infection started from the stubbles and from wild paddy and infected the nurseries at the beginning. The selection of healthy seedlings for planting in the field has to be adopted as a routine measure where effective control of the borer is desired. Light attracts insects during nights, especially during dark nights. If a light is set up in a field in the middle of a tray of water with a little kerosene added to it, the insects attracted by the light rush towards it, fall into the water below and die in large numbers. This system of trapping has been found successful as it attracts a very large number of female moths and is recommended as one of the methods of diminishing the moths and thereby reducing infestation.

The Paddy Grasshopper.

132. The paddy grasshopper occurs in a pest form in the Ganjam district and in South Malabar and its occurrence is an annual feature—the loss being sometimes total. The destruction of egg masses in the bunds in the off-season was finally decided upon as the most economical way of controlling the pest efficiently.

The Groundnut Hairy Caterpillar.

133. The hairy caterpillar pest of groundnut was intensively studied for over five seasons in Panruti and Malayampatti in the South Arcot district and it has been repeatedly found that hand-picking of moths before they laid eggs led to its control; this control method prevented the deposition of eggs and the consequent formation of huge armies of worms. There is a Pest Act in force (paragraph 323 making the non-picking of moths, etc., punishable. As a heavy attack results in a total loss of the crop there is a demand for the extension of the Act from the ryots themselves.

The Coconut Moth Caterpillar.

134. The damage done to the coconut trees by the moth caterpillar is very extensive in North and South Malabar. The green matter in the leaf is eaten up and the leaves are reduced to dry withering skeletons. The Pest Act (paragraph 324) was brought into force, and in 1929, a special staff was appointed to carry on the work of rearing the parasite enemies to destroy the worms that infested the leaves in numbers. This is an instance where the pests' enemies were utilized to fight the battle for the agriculturist with great advantage. There was also the Pest Act enforcing the cutting away of the severely affected fronds and burning them. The parasites had done such good work by 1933 that the further continuance of the Pest Act was not felt necessary afterwards.

The Mango Hopper.

135. The mango hoppers, nymphs and adults, cause damage to the flowers and prevent setting of fruits. There is, thus, a loss ranging from 25 per cent to almost cent per cent. Experiments carried out in Chandragiri, Anakapalle and Coimbatore demonstrate very clearly that the control of the insect by using fish oil resin soap sprays, twice at intervals of a week, is economical and profitable.

The Chillies Thrips.

136. Of late, chillies are badly subject to severe damage by minute sap sucking insects called 'thrips' as a result of which the leaves are thrown into curls, and flowers and pods are shed. Investigations undertaken at Guntur, Coimbatore and Madura go to show that weather plays a very prominent part in accelerating or diminishing the pest population. Dusting of plants and nurseries in the field with cheap finely ground tobacco dust was found to be pre-eminently the best control measure, but in places where high winds prevail, spraying may have to be done, using tobacco decoction.

The Pink Bollworm of Cotton.

137. The pink bollworm of cotton has been under study for some seasons. The general incidence in green and dry bolls was studied to get a general idea of the increase in infestation and the extent of damage to *kapas*. The influence of season and the effectiveness of the natural enemies in the natural control of the pest are under further study. The absence of long cycle larvæ (worms which remain as such for a longer period) and a wide range of host plants in South India is favourable for initiating the control measures. After the study of the life history of the moth, it was found that a dead season of a couple of months would effectively starve out moths that emerged later. With this object in view, the Pest Act (paragraph 322) is in operation, whereby the cotton plants are to be pulled out by 1st September. Comparative studies of the infections in the Pest Act areas and the non-Pest Act areas demonstrate that

the pest is going down slowly in the former but is on the increase in the latter. The object for which the Act was brought into force, is being realized.

The Cottony Cushion Scale.

138. Owing to an oversight of some of the nursery importers the cottony cushion scale was inadvertently imported in 1928 into the Nilgiris where it easily assumed pest proportions on the wattles. With the aid of the systematic knowledge, it was possible to determine that the insect was no other than the fluted scale of North America, where it very nearly threatened the citrus industry, and was very successfully controlled by the letting loose of a large number of predators, viz., the Lady-bird beetles. Soon a consignment was obtained from California and rearing on a large scale was done at Ketti in a laboratory sanctioned by Government in 1929. Within a year of introduction, the pest showed signs of going down and at present not much of it is heard.

Other Pests.

139. There are other problems that have been and are being studied; they are the fruit fly and moth problem in fruit-growing tracts, Deccan grasshopper, jasmine and betelvine bugs of the Ceded districts, sugarcane moth borer, paddy mealy bug, coconut beetles, stored product pests and house flies. Control measures have been devised wherever possible.

Study of Insecticides.

140. Closely connected with the above problems are the studies of the action of various insecticides or killing agents on different insects at different seasons. Cyanogas, tobacco, crude oil emulsion, fish oil resin soap, sulphur and calcium arsenate are found to be highly useful in the control of ordinary insect pests.

The Pricklypear Cochineal.

141. It is common knowledge that pricklypear has overrun a large tract of cultivable land and was encroaching into rivers, villages, roads, etc. By importing its insect enemy and liberating it, it was possible to check and destroy these hardy plants within a couple of years round about Ramnad and Tinnevelly. What was thought to be impossible of eradication has been achieved by the insect which is in great demand all over the presidency. Consignments of insects were supplied to various departments and other provinces which were faced with the same problem of the fast spreading pricklypear. Here again is a case of putting the beneficial insect to action against the plant that is considered undesirable.

Apiculture or Bee-keeping.

142. Apart from combating destructive insects, the Entomology section, is conducting researches on Apiculture and Ericulture. Wild colonies of bees are hived in properly designed hives, tamed and domesticated and they are found to thrive well in the new hives. There are at present 30 colonies attached to the apiary at the Insectary; the habits of the bees are being studied from various view points. The honey that is produced from the leaves and flowers of the various crops run to waste if not utilized. This wastage is prevented by making the bees go and collect the honey for which they are eminently fitted. Experiments conducted so far indicate that, with an initial outlay of Rs. 5–8–0 per hive, it is possible to make Rs. 12 to Rs. 15 per year and with 20 hives that one can easily manage, one should be able to make Rs. 240 in normal years. This would thus pay as a cottage industry. A short course has been instituted at the Agricultural College for giving practical training in bee-keeping.

Ericulture.

143. Ericulture is the raising of silk through eri worms. The eri silk is coarse, cheap and very durable. The worms are fed on castor leaves. Generally eight to nine generations of worms can be reared in a year. The relation of the production of cocoons to the weight of castor leaves fed is under study. Owing to general fall in price of all silks, this line of work is not enthusiastically taken up by the ryots, but with the coming of better time sericulture would be a useful cottage industry.

Systematic Entomology.

144. The need for the study of Systematic Entomology has been indicated under the Cottony Cushion Scale. Without good knowledge of Systematic Entomology, an insect with the potentialities of being a pest of the first magnitude, when imported freshly, may pass off unnoticed till it assumes pest proportions, when it might become well nigh impossible to undertake control measures without expending large sums of money. One would not be in a position to spot it out quite early without the help of a knowledge of Systematic Entomology. With such knowledge it might also be possible to avoid duplications of experiments in the control of insects. Therefore, the various families and genera of the insects which are definitely known to be harmful to crops in one stage or other are studied with reference to their structure and anatomy.

Propaganda.

145. The knowledge obtained as a result of research work is made available to the ryot through trained assistants attached to the various circles and it is now possible to give the quick and much

needed relief to ryots in far off places. Now the posting of assistants enables them to attend to calls with promptness to do the needful.

Exhibitions are organized on important festival days where mass gatherings are expected and the work done by the section is made known to them by lantern lectures, pamphlets and posters. The extensive output of publications in the shape of bulletins, pamphlets, etc., which are intended to help the ryot in his struggle against the pests of his crops are indications of the service brought home to the cultivator.

(*k*) Agricultural Engineering.

Agricultural Engineer.

146. The work started by Sir Alfred Chatterton in connexion with well boring and installation of pumping sets was taken over by the Agricultural department and put under the charge of a Government Agricultural Engineer. When the Department of Industries was re-organized in 1920, this work was taken over by that department and the Government Agricultural Engineer was thus freed to devote his attention to the improvement of agricultural implements and machinery. In order that he might collaborate with the Agricultural Officers of the department, his headquarters was transferred from Madras to Coimbatore, but here the lack of a properly equipped workshop and attention to other works which had to be undertaken left him very little opportunity for pursuing research in agricultural engineering and little or nothing was done in this direction.

Research Engineer.

147. It was not until the visit of the Royal Commission on Agriculture in 1926, that the question of agricultural engineering was given due consideration. In their report the Commission recommended the appointment of a Research Engineer to devote his whole attention to the study and improvement of the ryots' mechanical farm equipment, and in August 1928 this officer was appointed and the Research Engineering Section established. By 1931 the section was provided with an up-to-date workshop suitably equipped with a range of machine tools and all facilities for the task on hand. All kinds of agricultural implements and machines form the stock in trade of the section which has for its aims the improvement of indigenous types, the modification and adaptation of types introduced from other countries, and the evolution of new types. Particular attention is devoted to the more important items like ploughs and other tillage implements, seed drills, and water-lifts.

Iron Ploughs.

148. A large variety of iron ploughs have been put to test with a view to the determination of the types best suited to local conditions, and a range of ploughs has been selected after extensive comparative trials which is well adapted to the conditions of the various

tracts of the presidency. In most cases a certain amount of adjustment and simplification has been effected in adapting the designs to local methods of hitching and handling, the idiosyncrasies of the ryot, and the somewhat limited resources of local manufacture. These approved designs are all now manufactured in the country and supplies of ploughs and spare parts which are stocked for sale by the department in every taluk of the presidency, are inspected and tested from time to time to ensure the maintenance of the required standard of quality. Defects are promptly brought to the notice of the makers, and the possibility of improvement is ever under examination. By confining the types required to a small but adequate range, adopting a single standard model in each range, and a vigorous fostering of Indian manufacture combined with a rigid insistence on better methods of production and a much improved product, the department has been instrumental in reducing the general level of plough prices in the Madras Presidency by more than 50 per cent, and placing the Indian-made article in a very favourable and well-merited position. The number of ploughs sold from year to year through departmental depots shows a steady increase in spite of the most difficult times, the sales for the past three years being 1932—1,070; 1933—2,593; 1934—3,203.

Water-lifts.

149. Much attention is devoted to the subject of water-lifts. Designs of various types have been erected for trial and experiment including circular *mhotes*, Persina wheels, and bullock-driven pumps, some of which have been loaned for test or offered for development by manufacturers, agents and individual inventors. Improvements to the design of the well-known circular *mhote* of South Arcot district have resulted in a 40 per cent increase in output with a considerable reduction in draught and a decrease in cost.

Windmill Pumping Plants.

150. Two windmill pumping plants have been installed for trial and records have been maintained of daily outputs and daily average wind velocities. In addition, daily average wind velocities have been recorded over a period of five years on twelve Agricultural Research Stations in the various districts of the Presidency with the object of gauging the prospects of utilizing the natural wind power for pumping.

Seed Drills.

151. Experimentation with seed drills has led to the development of a simple and efficient design of mechanical drill for which a patent has been granted. Much attention has been directed to the improvement of indigenous wooden drills and the design of simple seed-sowing attachments. Such experiments have involved the complete construction in the workshops of many seed drills

and seed distributing devices of various designs, and constant modification and improvement following experience gained from extensive trials on departmental research stations and ryots' farms.

Pneumatic tyred wheels to Bullock Carts.

152. The fitting up of pneumatic tyred wheels to bullock carts, calling as it does for considerable change in present cart-design, is another matter for investigation which comes within the province of the section. Tests made by the section have demonstrated the advantage of the pneumatic tyres in respect of draught and loading capacity, and eight pneumatic tyred carts of various designs have been constructed and put under trial in the service of the department with the object of determining suitable types and investigating the cost of maintenance of the rubber-tyred equipment.

Ridging Implement.

153. A simple and efficient bullock-drawn implement for forming the usual irrigation bunds on ridges in garden lands has been devised after a good deal of experiment, and passed for production into the hands of local manufacturers. The implement is perfectly suited to the conditions under which it is required to operate, being as light in draught and as easily handled as the country plough and a definite saving in the cost of cultivation is effected by its use. It is available at a price within the reach of all, and demonstration by the department is resulting in a growing demand for it. This is an instance of the evolution and introduction of an entirely new design where nothing for the purpose save laborious and costly hand methods previously existed.

Experiments and Advice.

154. Experiments in the polishing of turmeric have resulted in the design of a simple mechanical polishing device capable of producing a better quality of finish and effecting a considerable reduction in the cost of treatment. Tillage implements of all kinds, sugarcane crushing mills and centrifugals, groundnut shellers, cotton gins, chaff-cutters, threshers and winnowers, and many other classes of implements and machines engage the attention of the section in numerous tests and experiments. Much advice is sought of the section on various subjects, designs are submitted for criticism, and many implements and machines are received for test from various sources. The section in return provides the fullest information, detailed reports of tests, plans and estimates, and many helpful suggestions. Other phases of the section's work include the design and construction of special implements and machines and apparatus for other research sections, and repairs and alterations to the implements and machinery of the Agricultural College and Research Stations.

(l) THE LIVESTOCK SECTION.

The Livestock Section.

155. A special officer designated "Deputy Director, Livestock," is devoting his attention solely to the improvement of the livestock of the presidency. His headquarters are at Hosur in the Salem district (27 miles from Bangalore) where there is a Livestock Research Station with a superintendent, farm managers, and a veterinary surgeon.

Livestock Research Station, Hosur.

156. In September 1924, the Agricultural department took over the old Hosur Remount Depot with about 1,660 acres of land, most of which is pasture. The surplus stock from the Coimbatore Agricultural College Dairy was transferred to Hosur and the breeding of cross-bred, *Ongole*, *Scinde* and *Kangayam* breeds was taken up. Milk animals are supplied periodically to the Agricultural College at Coimbatore for dairy purposes and the young stock at Coimbatore is transferred to Hosur for rearing. It was found that the *Ongole* cattle did not thrive so well in Hosur as they do in their native district and the breeding of these was discontinued at Hosur.

On the average about 650 animals are maintained at this station. These consist of *Kangayams*, *Scindes*, a small herd of *Hallikars* and a few cross-breds.

The Scinde Breed.

157. The *Scinde* from Karachi is recognized as the best dairy breed in India. The *Scinde* is compact and short and seems to do well throughout the presidency. About 70 Sind cows are maintained and they thrive even on scanty rations. The aim is to build up a good milk-yielding breed of cows for town milk supply. Bulls are ready for work at the age of 2½ to 3 years. The demand for this breed is very great and exceeds the supply. The average milk yield of the herd is 3,572 lb. with a daily average of 11·9 lb. for the foundation stock and 4,137 lb. with a daily average of 11·9 lb. for the farm-bred cows. The number of days in which the cows are in milk has thus shown an increase. Eight cows have yielded over 6,000 lb. of milk and 11 between 5,000 and 6,000 lb. in a single lactation. Cow No. 43 gave 7,118 lb. with a daily average of 17·7 lb. which works to nearly 4½ Madras measures per day on the average for the whole period in milk. Cow No. 25, which gave 5 calves, had an average record of 5,649 lb. with an average daily average of 16·9 lb. Taking the whole herd, the cows gave an average of 3,251 lb. of milk in 309 days with a daily average of 10·5 lb. The average number of days dry is 176; this includes first calvers. Cows calve on the average every 16 months. The weights of the calves at birth are 47 lb. for bull calves and 42 lb. for heifer calves. Heifers take the bull at an average age of 28 months and calve down at the age of 3 years and 2 months.

The Kangayam Breed.

158. The *Kangayam* is the best draft animal in the south of the presidency. It is compact and a bit short on the legs and is capable of doing well on a small farm. *Kangayams* are poor milkers; but there are some cows which give a good milk yield. The Hosur station is attempting to raise a strain with a high milk yield without impairing the draft qualities of the breed. A herd of about 170 cows is maintained. Endeavours are made to build up a herd of pure *Kangayam* which will breed true to type and to distribute breeding bulls and cows to the ryots in the southern districts for breeding purposes. There is a great demand for these bulls from this area. This breed responds to good feeding and bulls are ready for breeding purposes at the age of 2½ years on the average.

The average milk yield for the foundation cows is 1,493 lb. per lactation with a daily average of 6·2 lb. The average yield of farm-bred cows including several first calvers is 1,615 lb. with a daily average of 6·6 lb. in 244 days. The highest yield recorded up to date is 4,105 lb. with a daily average of 10·9 lb. Cows calve on the average every 14 months. The average weights of calves at birth are 46 lb. for a bull calf and 42 lb. of a heifer calf. A heifer calves down at the average age of 3 years 2 months.

The Cross-bred Herd.

159. Cross-breeding experiments with Ayrshire bulls and *Scinde* and *Sahewal* cows were being carried out at the Military Dairy Farm, Bangalore, in order to ascertain if a new breed of milch cow could be evolved. In 1923 several half-bred cows born in the experiment were purchased by the department and transferred to the Agricultural College Dairy, Coimbatore. Cross-breeding was continued. The daily milk yield gradually increased. In 1927–28 the daily average yield per cow was 16 lb. of milk, the cross-breds being in milk for three months more in a lactation than the *Scindes*.

The half-bred cows and heifers cannot keep up on the low ration and poor conditions on the plains and keep fit like the indigenous breeds. They are all right so long as they are fed and housed well and naturally a good milker pays for this. Cross-breeds seen in the districts in the hands of landowners have not the ideal bloom or appearance.

The number of cross-bred cows in Madras City has increased considerably during the last 12 years and dairymen will rarely part with a cow or heifer with signs of imported blood in it. Moreover, it is rare to see a cross-bred heifer calf in poor condition. These facts speak for themselves and the opinion held by the dairyman, who has to make his living out of the industry, carries a considerable weight, and this is in favour of the cross-bred cow for a city milk supply. What the average farmer wants is both milk and work. All the half-bred and other cross-bred cows are now being mated to a pure *Scinde* bull in order to breed back to the indigenous

breed. Several of these one-fourth-bred cows have yielded over 5,000 lb. milk in a lactation. They resemble the indigenous animals. They have humps, and their size, conformation and coats are better while the heifers appear to be more thrifty feeders than the half-breds. A breed good for milk and work is thus being built up.

The Hallikar Breed.

160. The *Hallikar* is a Mysore breed. In north Coimbatore, Salem and Chittoor districts there is a breed of cattle named *Alambadi*, similar in conformation to the Mysore breeds. It is a breed built up by the use of Mysore bulls. A nucleus herd of 22 cows and 2 breeding bulls of the *Hallikar* breed was purchased in January 1935 and is maintained at the Hosur station. Bulls for breeding purposes will be sold to the ryots in the abovementioned districts for improving their local cattle.

The Ongole Cattle Farm, Chintaladevi.

161. In 1919, 46 cows and 5 bulls were purchased in the Ongole tract to serve as foundation stock for the *Ongole* Cattle-breeding Station, which was started at Chintaladevi, in the Kavali taluk of the Nellore district. Breeding was carried on by selection; irregular breeders and other defective animals were weeded out annually and about 25 of the foundation cows were retained. The heifers born to these cows were carefully reared, the best animals were retained for the farm and mated to good bulls. The others were sold away. On the average about 200 heads of stock were maintained on this farm up to 1932. The performances of the cows as worked out in 1931 were as follows :—The average milk yield for the foundation stock was 2,674 lb. with a daily average of 9·8 lb. and for farm-bred cows—3,526 lb. with a daily average of 11·5 lb. Farm-bred cows showed an increase of 852 lb. in a lactation with a daily average increase of 1·7 lb. per cow. The highest individual yield in a lactation was, for the foundation stock 5,422 lb. with a daily average of 14·1 lb. and for farm-bred cows—7,190 lb. with a daily average of 21·5 lb. At the station 10 cows yielded over 5,000 lb. of milk and 12 cows between 4,000 and 5,000 lb. in a single lactation. The best individual average milk yields were for the foundation stock—3,761 lb. with a daily average of 11·5 lb. and for farm-bred cows (4 in number) they were—5,682 lb., 5,714 lb., 5,258 lb. and 5,361 lb. with daily averages of 17·1, 16·1, 14·0 and 13·7 lb. respectively. The average dry period worked out to 177 days for foundation cows and 147 days for farm-bred cows. In the farm stock heifers calved down at the age of three years and four months on the average whereas in the district they do so at 4 to 4½ years of age. The average weights of the calves at birth were 65½ lb. for the bull calf and 60 lb. for the heifer calf. An all round improvement will thus be noticed from the above figures. This important line of advance received a heavy set-back due to retrenchment. In 1932 most of the stock was sold away and the Ongole Cattle Farm at Chintaladevi was closed. Seventeen of the best

cows and heifers together with their calves and the breeding bulls were transferred to the Agricultural Research Station, Guntur, and the work on these is being continued at that station on a very restricted scale.

Livestock improvement is not a quick piece of work. It takes a long time to show progress. The foundations of this important work have to be laid soundly. Mistakes cost money and time. That being so the heavy hand of retrenchment has affected work on this most important breed of *Ongoles*, the pride of Madras and renowned all over the world. It is hoped that it will not be long before a new centre of work for the improvement of the *Ongole* breed is re-started and uninterruptedly maintained.

Survey of Ongole Cattle.

162. In the year 1927, a survey of the Ongole breeding tract was made and valuable information gathered. Eight hundred and forty-four villages were visited and it was found that there were about 93,000 cows of the Ongole breed together with 789 breeding bulls of which 119 were old and useless, thus leaving 670 bulls fit for breeding. This number is very low. It was found that there were 316 villages which had no breeding bulls at all and 148 of these possessed 60 or more cows of the *Ongole* breed. Most of the services take place during two periods of the year—February to March and August to September. All the bulls are *Brahmini* bulls with the exception of 13 which are privately owned. About 42,000 calves are born annually. The heifer calves are not cared for so well and the mortality amongst them is rather high, when compared with bull calves. On an average an *Ongole* cow produces 4 or 5 calves during her lifetime in the district, whereas on Government farms they produce 7 to 9 calves. About 2,500 *Ongole* cows are exported annually from the Nellore district to Madras for milk supply. Others are sold to dealers from Godavari, Hyderabad and other places. About 21,700 bull calves are born annually and it is estimated, after the requirements of the district are met, that about 30 to 40 per cent of these are sold away to dealers from other districts for work purposes. These facts justify the imminent need for active steps to improve this breed.

Buffalo Breeding Station, Guntur.

163. In 1923 a breeding station solely devoted to the breeding of buffaloes was opened at the Agricultural Research Station, Guntur. One hundred and fifty acres of grazing land in the hamlet of Lam was taken over for this purpose. The herd consisted of 11 Delhi and half-bred Delhi she-buffaloes transferred from the Agricultural College Dairy, Coimbatore, and 10 *Murra* she-buffaloes with calves that were purchased in 1930. The average yield of the Delhi and *Murra* buffaloes was 4,800 lb. per lactation with a daily average of 14·1 lb. The highest yield for one lactation was 9,610 lb. with a daily average of 18·9 lb. The average number of days in milk was 344 and the average number of days dry 201. The

grading up of the half-bred Delhi she-buffaloes with a pure Delhi bull is the line of work undertaken. From the commencement of the farm 52 buffalo bulls and 78 she-baffaloes have been disposed of. Consequent on retrenchment the number of stock was considerably reduced. Six she-buffaloes together with their progeny and two breeding bulls form the present depleted stock in this important line of livestock improvement. It is hoped that with the dawn of better times a separate fully stocked buffalo station will soon be a wing of livestock research.

Sheep.

164. With the starting of a Livestock Research Station the work on sheep at Hagari in the Bellary district was transferred to Hosur. A flock of 130 sheep of the Bellary breed is maintained here and is thriving. The aim is to try and evolve a white wool bearing sheep which will breed true to type and produce good white wool and will fatten quickly. Of the types of sheep, the one with a white body and a black face is usually vigorous, gives good wool and fattens fairly well. But this type is usually impure in that it throws sheep of other colours and does not thus breed true. Sheep all-white in colour, born of these black-faced whites, are not vigorous. Out of the 44 all-white lambs, 29 died. These lambs are small in size and do not grow so well as the others. White black-faced rams weigh on an average 122 lb. and yield about 7 lb. of wool. All-white rams weigh about 85 lb. and yield less than 5 lb. of wool. These facts go to show the limitations in the way of reaching an ideal. Hereditary factors set some of these limitations. A knowledge of these hereditary factors and the general hereditary make up of the different breeds is thus an important subject of study. It is proposed to try and introduce new indigenous blood such as the Bikaner in crosses designed to achieve this ideal of an all-white sheep good for wool and mutton.

Poultry.

165. During recent years the demand for poultry has considerably increased especially in places near towns. The interest in poultry farming has been stimulated as it is a valuable cottage industry. Apart from home use, there is a small margin of profit. The birds utilize large quantities of waste products on the farm. They are of valuable help in the eradication of insects on the farm, both on the young crop and in fallow land. With a view to improve meat and the capacity for laying eggs, breeds of imported stock are maintained in several of the agricultural research stations. The breeds kept at the Hosur Livestock Research Station are, White Leghorn, Black Minorca, Light Sussex and Rhode Island Red of imported breeds and the indigenous breeds Chittogong and Tellicherry (Black skinned). The average egg yield in a pullet year is easily over 150 in the case of imported birds. In the case of White Leghorns the highest individual yield was 236. About 400 birds and chickens are maintained and eggs for hatching are sent all over the presidency. During the last four years there has been

a great demand for poultry, and eggs, chickens and birds are sold in large numbers to the public for breeding purposes. As a result of this intensive poultry keeping suitable rations have been worked out and poultry houses suitable for the plains and the hills have been devised. Many pamphlets embodying these experiences have been issued to the public.

Pigs.

166. Pigs are kept for the purpose of making the best use of dairy surplus butter-milk and other waste produce of the farm. Berkshire and Yorkshire white pigs are the two breeds kept. These are kept for consuming the by-products of the dairy both at Coimbatore and at Hosur. Piglings are generally sent from Hosur to Coimbatore for rearing and fattening. There is a good demand for these from butchers for table purposes.

Premium Scheme for Breeding Bulls.

167. It takes a very long time to rear and send out breeding bulls to all localities where they are needed. Local *Brahmini* bulls are of unknown or indifferent quality. To meet the need for good breeding bulls a scheme has been in operation awarding a premium and thus encouraging cattle improvement. The annual premium could be awarded for three years and is up to Rs. 50 towards care and management, and another Rs. 50 towards the number of services performed. These are awarded on the recommendation of an agricultural officer whose inspection ensures proper quality and maintenance. A prize of Rs. 5 each is also offered each year for the best bull calf and the best heifer calf born to each bull. This encourages people to look after the calves better. In 1934 there were 87 approved breeding bulls in the scheme as against 14 in 1928. The majority of these bulls have been bred on Government farms.

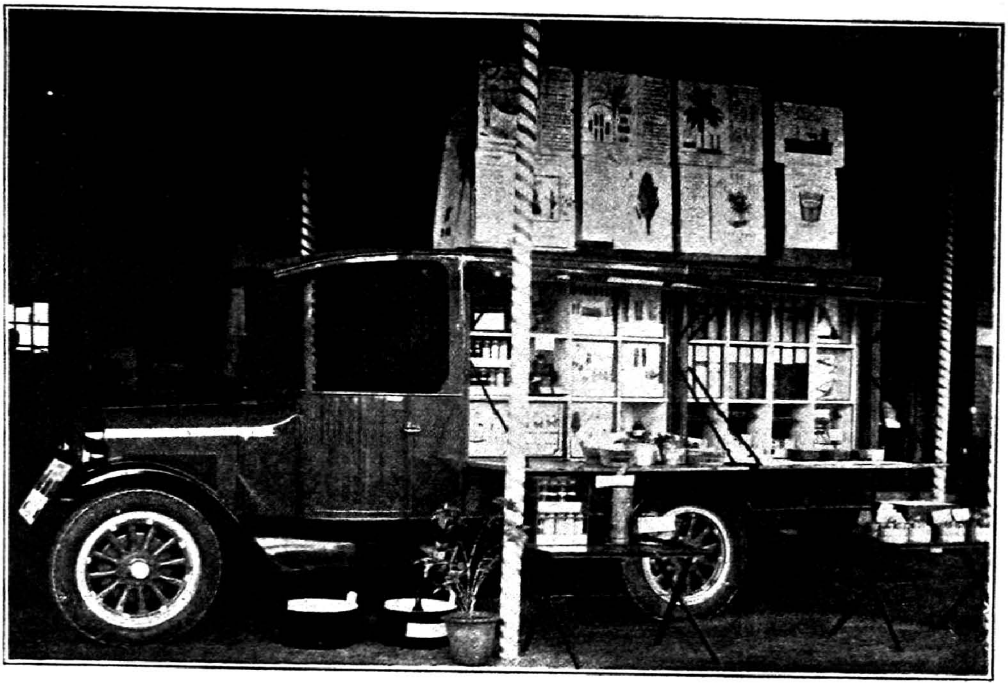
Breeding Bulls in Veterinary Hospitals and Agricultural Research Stations.

168. There are seven bulls including buffalo bulls maintained at the Madras Veterinary College for the service of the cows and she-buffaloes in the Madras City. An Assistant Agricultural Demonstrator is in charge and he advises milkmen and others on the rearing and feeding of calves and clean milking methods.

There are 48 breeding bulls maintained by Government in different parts of the presidency. This is in addition to those maintained by District Boards, Panchayat Boards and Co-operative Societies.

Sale of Livestock.

169. From 1924 up to 1935—438 bulls, 52 buffalo bulls, 602 cows, 78 she-buffaloes and 252 young stock have been disposed of for breeding purposes. These livestock are bound to leave their imprint in the areas in which they serve, and thus help to tone up the general level of the quality of the local livestock.



THE MOTOR EXHIBITION VAN.

[*To face Chapter IV.*

CHAPTER IV.

RESEARCH AND DEMONSTRATION IN THE DISTRICTS.

(a) The Vizagapatam Circle.

The First Circle.

170. The first (Vizagapatam) circle comprises the four districts of Ganjam, Vizagapatam, East Godavari and West Godavari. It is in charge of a Deputy Director, with headquarters at Vizagapatam. There are two Assistant Directors of Agriculture, one at Vizagapatam, in charge of the Ganjam and the Vizagapatam districts, and the other at Rajahmundry in charge of the two Godavari districts. There are 24 Agricultural Demonstrators each in charge of a taluk. Nine taluks are without demonstrators. There are 79 demonstration *maistris* of whom 72 are employed in the intensive demonstration scheme tried as an experiment in the Vizagapatam division (paragraph 31).

There is an Agricultural Research Station at Samalkota in the East Godavari district, under the Deputy Director. There are three other research stations. The one at Berhampore in the Ganjam district is financed by the Imperial Council of Agricultural Research. This and the research station at Maruteru in the West Godavari district are both under the control of the Paddy Specialist at Coimbatore. These two stations are under gazetted Superintendents. The Agricultural Research Station at Anakapalle in the Vizagapatam district is also under a Superintendent who is a Specialist in Sugarcane.

The total cultivated area in the circle is 7,207,000 acres. The acreages of the principal crops are, paddy—3,487,000, millets—1,525,000, pulses—772,000, oil seeds—719,000, mangoes—102,000, tobacco—76,000, chillies—61,300, sugarcane—47,700, cotton—25,900, plantains—16,700 and fodder crops—45,200.

Paddy.

171. Paddy occupies half the cultivated area in the circle. Till 1927, paddy was selling at a good price and consequently the improvement advocated by the department regarding this crop were easily adopted by the ryots. New varieties were introduced, the seed-rate was reduced and the economic transplantation of seedlings was practiced on a large area. These practices have become almost universal in the two Godavari districts. In 1927 the financial depression set in and affected the trade in rice with the result that the market price for paddy went down as low as Rs. 2¼ per bag of 166 lb. Steps had, therefore, to be taken by this department for coming to the relief of the paddy growers thus adversely affected by the depression. The reduction to a certain extent of the area

under paddy was suggested, the growing of more economic crops such as plantain and sugarcane was advocated, and the necessary advice in the cultivation of these crops was given to the ryots. Nevertheless, work on paddy improvement was not slackened. Swamp paddies from Bengal are being tried in many low-lying areas subject to inundations. Improved varieties and strains were introduced over an area of 2½ lakhs of acres. To ensure a continuous supply of pure seed an area of 6,500 acres was brought under seed-farms. By the introduction of many improved varieties over a wide area, an enhanced annual income of nearly 7 lakhs of rupees has accrued to the paddy growers in this circle, the gain per acre being calculated at Rs. 3. Ten years ago under more favourable conditions in the rice trade, the area under improved strains was only 14,000 acres with a financial gain of over Rs. 63,000 worked at Rs. 4½ an acre.

Sugarcane.

172. Of the one lakh of acres under sugarcane in this presidency, nearly half is in the first circle. In this circle the district of Vizagapatam has in it nearly a third of the presidency area. Sugarcane is, therefore, one of the important crops in this circle. The Purple Mauritius variety of sugarcane is the one commonly grown in the two Godavari districts. As this cane is liable to the attack of red-rot, resistant canes like J. 247 were introduced and their area increased to over 14,400 acres. A number of Coimbatore thin canes were also tried and of these a prominent variety, Co. 213 was very successful. This is a cane for which wrapping the canes with its leaves and propping them with bamboos are not ordinarily necessary and so the ryot was relieved of two big items of expenditure and could thus reduce his cost of cultivation. Co. 213 now occupies an area of 2,300 acres in this circle. Improved varieties of canes now cover 16,700 acres, an area twice that of ten years ago. Calculating the gain by these introductions, at about Rs. 30 per acre, the total gain comes to nearly 4½ lakhs of rupees. Other improvements introduced and popularized are the selection of seed-setts and the planting of these in lines, with a greater spacing between the rows, growing a short crop (paragraph 101) for seed-setts, and the use of efficient sugar mills. Of these improvements, line planting has been adopted over an area of 11,000 acres (as against the 100 acres of 1922) with considerable economy in the cost of cultivation. The gain by this improvement can be evaluated at Rs. 3 lakhs, giving a total combined gain of Rs. 7½ lakhs for the circle. About 800 demonstrations in improved methods of making ordinary and cream jaggery (paragraph 52) were given. Improved furnaces for jaggery making were constructed in 880 places.

Plantains.

173. The plantain is an important industrial crop of the circle and the area under this is increasing. Nearly 20,000 acres are at present occupied by this crop. The main improvement advocated

is in the system of cultivation, viz., planting single suckers, wide spacing, heavy manuring, trenching between the rows, and removing superfluous side shoots. The main variety that is grown with these improvements is *Karpura Chekkarakeli*. *White Chekkarakeli* and *Bontha* are also cultivated in areas where there is a demand for them. These improvements have been adopted over an area of 5,000 acres bringing an extra remuneration (at Rs. 60 per acre) of Rs. 3 lakhs.

Manurial and cultural trials with plantains are conducted on the Samalkota station. In addition to the application of cattle manure, the use of cake and ammonium sulphate results in plants throwing big bunches. It has been found that the crop planted in December–January comes to harvest in the next December to March and that planted in June is ready for harvest in February to April. This experience permits of plantain growing in both garden and wet lands and results in a regulated supply to the market.

Other Crops.

174. Departmental strains of *Ragi*, Nos. 525 and 355 were introduced for the benefit of the upland ryots. In groundnuts spacing experiments showed that sowing in every furrow instead of in alternate furrows as is the common practice, increases the yield. This improvement was popularized. *Pillipesara* was introduced as a fodder crop over nearly 7,000 acres. The average income from this crop is about Rs. 15 per acre and this introduction has meant a considerable enhancement in the fodder resources of the cultivators. Fruit crops like citrus, mango, sapota and pine-apple received attention and a "GROW MORE FRUIT" campaign was conducted by the department. The chief activities with regard to these fruit crops are the selection of suitable sites, advice regarding proper planting, judicious manuring, ring and furrow system of irrigation, scientific pruning and the taking of timely remedial measures against pests and diseases. Pine-apple was introduced for the first time in many places.

Manures.

175. The proper preservation of manure and cattle urine is an important point which had to be impressed on the minds of the ryots. In 1934 in more than 10,000 cases the proper method of preserving manure was demonstrated. The use of paddy straw as litter was emphasized. Growing green manure crops has become a common practice with the ryots and the area under these is increasing year by year. The estimated area in the circle under green manure crops is about 70,000 acres against the 6,000 acres 12 years ago, and there is a gain of Rs. 4 per acre by growing these crops. Till 1929, artificial manures were stocked by demonstrators in Government depots and sold to the cultivators. Private companies have gradually come into the field and the bulk of the work is now in their hands.

Improved Implements.

176. With the introduction of the *takkavi* loan system for purchasing implements, improved implements and tools began to find more favour with the ryots, and a large number of them took advantage of this concession. About a thousand improved ploughs are in use at present. The chief improved implements are ploughs like Cooper No. 11, improved mhote buckets, roll-easy mhote wheels, *guntakas*, hoeing implements and horticulutral tools. About 2,700 demonstrations with improved implements were given in 1934.

Co-operation.

177. The department kept close touch with the Co-operative organizations and help was rendered to a number of societies and unions in meeting their agricultural requirements. The chief items of work in this connexion are the distribution of good paddy seed, sale of agricultural implements through Co-operative societies, holding of Agricultural Exhibitions during Co-operative Conferences, helping Co-operative Sugarcane Factories with advice in growing suitable varieties of canes, the encouragement of the sale of jaggery through the Loan and Sale Society at Anakapalle and the starting of a co-operative society for the extraction of coconut fibre at Amalapuram.

Livestock.

178. The improvement of the existing breeds of cattle was another important item of propaganda. Three Nellore breeding bulls are maintained at the Anakapalle Station. One half-bred Delhi buffalo and three Ongoles are under the premium scheme (paragraph 167). Proper housing and a judicious use of concentrates in cattle feed were advocated.

Poultry and Bee-keeping.

179. New and better breeds of poultry like the Leghorn and Rhode Island Reds were introduced in several places in this circle. A specially trained poultry assistant is at present posted to the Anakapalle Research Station to build up a stock and to do propaganda work among the farmers of the circle.

Bee-keeping is becoming a great favourite cottage industry and more than 100 hives are now maintained as a result of the departmental help.

Pests and Diseases.

180. Entomological and Mycological assistants for dealing with insect pests and fungus diseases of crops are stationed at the Samalkota Research Station and respond to calls for help. There have been over 200 such calls in 1934.

Samalkota Research Station.

181. On the Agricultural Research Station, Samalkota, research on paddy, sugarcane, and plantain is being conducted. Over 200 selections of paddy are on hand and *Punasa Akkullu* 3, and *Punasa Konamani* 2 have each given over 3,500 lb. of grain per acre. In sugarcane 55 varieties are under study and of these P.O.J. 2878, Co. 356, Co. 403 and Co. 419 are found to be very good. The water requirements of paddy and sugarcane are under study. Grape, fig, pomegranate and orange have been recently planted. Medicinal plants such as *omum*, coriander, cumin, senna, garlic and linseed are grown with success. Work on bee-keeping, poultry and fruit preservation is also in progress. Four new kinds of fish have been introduced into the nursery pond at the station.

Anakapalle Research Station.

182. The Agricultural Research Station, Anakapalle, has now become primarily the headquarters for specialization in sugarcane. In the special chapter on sugarcane will be found an account of improvements in this important crop. Besides cane, work on other important crops is in progress.

The improvement of paddy was taken up in 1924. Single plant selections with a view to evolve pure high yielding strains was resorted to. This intensive work has resulted in eight promising strains which after careful comparisons have proved very good. These have spread over an area of nearly 8,000 acres in Ganjam and Vizagapatam districts.

Ragi is another of the principal food crops in the circle. The improvement of this crop was undertaken and extensive selections and comparative trials made. Early *ragi* (*Punasa*) strains No. 355 and No. 525 have proved very good and have been given out to the cultivators. In 1934, these improved strains covered an area of over 1,000 acres. Good strains of late ragi (*Pairu*) Nos. 279 and Vizagapatam 33, have also been distributed.

An orchard in which Australian and Batavian varieties of oranges and different varieties of Pomelo have been planted, has commenced to flower and much valuable information on citrus, its culture and pests is being obtained.

An apiary and a piggery are attached to this station. There are seri-cultural activities also.

Juvenile Labourers' School.

183. A juvenile labourer's school attached to the station is working for over 16 years very satisfactorily. The boys after leaving the school are employed either as permanent coolies on the station or as demonstration *maistris* or coolies, out in the district. About 35 per cent of the labour employed on the station is literate and this is the direct result of the efforts at the school.

Literate Labour.

184. The employment of literate young men for labour forms one of the important items of work on the station. The qualifications of these lads range from the 8th standard to eligible Secondary School-Leaving Certificate. There are at present 20 such young men on the station and 20 others trained on the station were recently employed as demonstration *maistris* under the new scheme of intensive demonstration specially sanctioned for the Vizagapatam district.

(b) THE GUNTUR CIRCLE.

The Second Circle.

185. The second (Guntur) circle comprises the districts of Kistna, Guntur and Nellore and is in the charge of a Deputy Director of Agriculture, with headquarters at Guntur assisted by an Assistant Director of Agriculture at Nellore, with jurisdiction over the Nellore and Guntur districts. There are 17 demonstrators and 11 demonstration *maistris* in the circle. Fifteen taluks and divisions are without demonstrators. This circle was constituted in 1921 and the record of the work in the circle covers the period under review.

The cultivated area in this circle is 5,175,000 acres. The acreages of the chief crops are, millets—1,774,000, paddy—1,389,000, oil seeds—439,000, pulses—344,000, fodder crops—272,000, cotton—153,000, tobacco—101,000, chillies—89,900, coriander—45,800, and turmeric—12,200.

Guntur Research Station.

186. In June 1922 an Agricultural Research Station was opened at Guntur for the study and improvement of the principal dry crops of the circle. Three hundred acres of black cotton soil out of the forest reserve in the village of Lam, 5 miles north of Guntur, were taken over. About half the area was reclaimed for cultivation and the rest left over for grazing.

Cotton.

187. The local cotton goes under the trade name 'Cocanadas.' Unlike other cottons, it has brownish lint and is much wanted by the traders for its capacity to keep colours fast. As a result of breeding work done at Guntur, a strain No. 171 has been isolated. It has a length of 7/8 inch and a ginning percentage of 26. It yields 10 per cent more than the local unselected cotton. It spins up to 26's while the cotton from which it was selected spins only 16 to 18's. This strain is being rapidly multiplied for distribution and it is hoped that this will be grown over very large areas before long. Four other strains are under trial in an endeavour to excel strain No. 171.

The proper spacing of plants in a cotton crop is a matter of importance and will vary with the tract and the variety. Experiments at Guntur on Cocanadas show that a 9 inches spacing between plants in the line and 2 feet between the lines is the best.

A proper rotation of crops with cotton was the subject of investigation and several trials made, go to prove that cotton after groundnut is very profitable and cotton after *sajja* is the next best.

Taking advantage of the even distribution of rainfall and the clayey soils that retain moisture, Cambodia cotton, usually an irrigated crop, was tried under rainfed conditions and found to yield much better than the local cotton sown in September. Experiments as to the best time for sowing Cambodia cotton show that July sowings are the most desirable. Rainfed Cambodia cotton responds best in lands naturally fertile or well manured. In such lands it is calculated that there is a gain of over Rs. 10 per acre by growing a Cambodia crop in place of the local cotton.

Tobacco.

188. India's trade in tobacco with Great Britain is a valuable one. With "preference," it is bound to increase in importance. There is a definite demand for good cigarette tobacco. To obtain a golden yellow colour in the tobacco leaf, flue curing in barns has become very popular. The number of flue curing barns has gone up from hundreds to thousands in the tobacco areas of the Guntur district, a fact of significant importance. At the Guntur Station selection in the local tobacco and hybridization with Virginian varieties are in progress. Six selections of the requisite type have been isolated and are in the stage of comparative trial. The best of these will be distributed to the cultivators shortly. The immense possibilities of this line of work will be evident when we realize how eminently suited Guntur is for this special work on tobacco and when it is calculated that an easy gain of Rs. 100 per acre can be obtained by the introduction of Virginian varieties. The area under tobacco in the Guntur district in 1934 is nearly 120,000 acres approaching half the total area under tobacco in the presidency. The question of improving tobacco is an All-India one and it is gratifying to note that the Imperial Government is taking active steps to start a station for tobacco improvement in the Guntur area.

Chillies.

189. A little less than a fourth of the presidency area under chillies is in the district of Guntur. Work in the selection of suitable types in this condiment is in progress. The aim is to have heavy yields, uniform and early ripening, a good red colour and a persistant calyx which prevents seed shedding. Six selections that are promising are under comparative trial at the Research Station, Guntur. Resistance to the attack of thrips is another important consideration. To tackle an attack of thrips several remedial measures were tried and dusting with tobacco powder was found to be

efficient and economical. Demonstrations of this dusting have been undertaken on a wide scale in ryots' fields. Pending the evolution of other strains at the Research Station, strain No. Pusa 46 was introduced into the district. This strain gave a 10 per cent increased yield and was found to be largely resistant to the attack of thrips.

Paddy.

190. The first improvement that was effected in the paddy crop was the thin sowing of seed beds in the Nellore district where a heavy seed rate was being used. After five years of constant advice and demonstration the seed rate has been considerably reduced and the number of seedlings transplanted lessened. This improvement has been effected in such areas of the Guntur district also as practised a heavy seed rate. The most important improvement effected in this crop was the introduction of high yielding varieties. Strain No. G.E.B. 24 from Coimbatore, famous for its fine rice, spread over the area in spite of its poor yield in straw. In heavy soils, this strain could not compete with local varieties. Aduturai varieties were introduced into the Nellore district. Adt. 65 and Adt. 11 proved superior to the local variety *Molakolukulu.* Coimbatore and Maruteru strains are on the eve of distribution to replace the local varieties, *Easwarakora* and *Kesari.* In the Guntur and Kistna districts Maruteru strains *Kusuma C* (Mtu. 7) and *Akkullu* 34 (medium quality varieties) proved very suitable. Among fine quality varieties *Kistna Katukulu* strain (Mtu. 8) was good and given out for distribution. The total estimated area under improved strain of paddy in the circle was 53,000 acres in 1934. Taking the minimum nett gain as Rs. 5 per acre, these improved strains have enriched the paddy growers in this circle to the extent of well over 2½ lakhs of rupees.

Sugarcane.

191. Purple and Red Mauritius varieties of cane have been in existence in this circle for a very long time, grown in small areas. Where the land was rich and wells easily sunk, the cultivator grew a patch of cane and made jaggery out of it in his own crude way. Till 1931, the help given was the introduction of good cane mills and boiling pans and the demonstration of jaggery-making on improved furnaces. In 1931 some Coimbatore varieties of sugarcane, notably Co. 213, that were tried at Anakapalle were introduced in Gudivada and Chellapalle in the Kistna district. The area under these varieties was multiplied, having recourse to the Java method of " short planting " (paragraph 101). In 1933 there was a proposal to construct a sugar factory at Vuyyur in the Kistna district. This gave an impetus to the cultivation of cane and about 2,600 acres were under it in 1934. The factory could not be completed in the expected time and all the cane grown to be consumed by the factory had to be handled otherwise. In this situation, the Agricultural Department, in collaboration with the Industries and Irrigation Departments, afforded the necessary help to the cultivators. Power

crushers were erected. Opportunities were availed of for demonstrating the construction of improved furnaces and the proper method of making jaggery. With the help of a field refractometer the sugarcane growers were taught to gauge the proper stage of ripeness of cane. All this has served to educate the cultivators in growing and handling this important industrial crop. With the starting of the factory at Vuyyur, these experiences gained in sugarcane growing should easily contribute to the rapid spread of the area under cane. The advent of this paying crop has meant a clear gain of nearly Rs. 3 lakhs for the Kistna district, calculated at the rate of Rs. 80 per acre.

Turmeric.

192. Turmeric is grown on nearly 48,000 acres in the presidency. Of this one-fourth of the area is in this circle. It is, therefore, an important commercial crop of the circle. The planting of the turmeric crop on ridges instead of in beds was demonstrated with such a great effect that it has become quite a common practice now with the ryot. Boiling turmeric in an improved pan on a fuel-saving furnace was also demonstrated with success. With the fall in the price of turmeric, the ryot is not keen on venturing to invest capital in the purchase of the pan and the construction of furnace. This is another instance of the set-back to a successful item of propaganda, imposed by the trade situation.

Other Crops.

193. A.H. 45, a strain of the bunch variety of groundnut evolved by the Oil Seeds Specialist was compared with the local variety and proved very superior to it. This selection is being distributed. In the spreading variety of groundnut, a good strain, No. A.H. 25, is also under distribution. Selection of desirable types of *Jonna* in the *Punasa* and *Pairu* seasons is in progress. Of the several varieties of soya beans tried, *Kachin* and *Laredo* have proved suitable to Guntur conditions. Ginger was introduced recently in the Tenali taluk with considerable success. The ryots are now trying to grow it under the shade in orange gardens. The proceeds from ginger come in handy as a supplementary income to them. Selected seed coconuts from the West Coast and the Godavari district are being supplied every year to the ryots. The demand for the nuts is very great. The system of raising a green manure crop in the beds round coconut trees and working it in along with bonemeal is being demonstrated. In plantain *Chekkarakeli* and *Karpurachekkarakeli* varieties have been introduced and have spread all over the Tenali taluk. Among medicinal plants *senna* has fared well.

Fodder Crops.

194. The Guntur circle is the largest in point of acreage of fodder crops. Attention was, therefore, paid to these crops. The practice of growing sunnhemp for fodder after paddy was introduced

in the Nellore district. This practice is now being gradually adopted. The growing of *Pillipesara* as a fodder crop in dry black cotton soils was demonstrated with success in several places. It is taken up by the ryot freely because it gives a good fodder without impoverishing the soil. In *jonna*, the Nandyal strain T-6 was introduced. This strain has sweet stalks and its fodder is relished by cattle better than the local *jonna*. In fodder yield it is equal to the local *jonna*. After trials, the best sowing season for this new introduction was determined to be the *pairu* season. There is a large demand for its seed, which is being met.

Fruits.

195. The area under fruit gardens is on the increase. Six hundred and fifty acres were planted as a result of propaganda by the department. Good varieties of mango, Batavian orange, sapota, grape and Kew pineapples have been introduced. Demonstrations in the system of irrigation in a trench away from the trunk of the tree, inter-cultivation, green-manuring, proper pruning and spraying and otherwise treating trees against diseases were conducted with success. The call for departmental help in this direction is ever on the increase.

Reclamation Crops.

196. There are large swampy areas in the Guntur and Kistna districts. To utilize such areas to advantage, slips of *korai* (Cyperus sp.) were introduced from the Nellore swamps. The *korai*, if established, should provide material for the useful cottage industry of mat-making. With a view to the possible utilization of the vast low-lying sandy areas in the Guntur district seedlings of bamboo have been raised at Bapatla to be planted out when sufficiently grown up.

Livestock.

197. Advantage was taken of the 125 acres of grazing area attached to the Agricultural Research Station, Guntur, to open a Buffalo Breeding Station in the Guntur tract, which has one-third the number of buffaloes in the presidency. The Delhi breed was introduced. In this breed the males are strong and well built. She-buffaloes are heavy milkers with a good percentage of butter fat. The aim is to distribute breeding buffaloes reared at Guntur over the tract and gradually grade up the local breed. This Buffalo Breeding Station was growing up vigorously till 1932, in which year, consequent on retrenchment, the Ongole Cattle Breeding Station at Chintaldevi in the interior of the Nellore district was abolished and a select herd of Nellore cows and bulls was transferred to Guntur. The housing of these necessitated a clipping down of the buffalo herd. The cattle and the buffalœs are now a part of the Agricultural Research Station. This pedigreed herd awaits favourable times to develop again into a full fledged Livestock Research Station catering to the improvement of the famous

Nellore breed of cattle and the local buffaloes. Half a dozen breeding bulls are under the premium scheme. With the object of supplying improved breeds of poultry, Rhode Island Reds and Black Minorcas were obtained and bred on the Guntur farm. Eggs and chicks are being supplied to the public for hatching and rearing. The demand for these is so great that the Guntur farm is unable to meet it and supplies are being obtained from the Livestock Research Station, Hosur.

Demonstration and Propaganda.

198. Demonstrations are generally conducted on the basis of experience gained in the Research Station of a circle, and the results of practical trials on private holdings. But it so happened in this circle that the commencement of district work and the opening of the Agricultural Research Station at Guntur coincided. The Guntur Station is a dry land farm and there is no research station in the circle for work on garden and wet land crops. This defect notwithstanding, the district work was pushed through taking advantage of the experience and strains of improved seed of the neighbouring tracts. Practical demonstrations in the use of improved implements were conducted and the benefits accruing from the use of special manures and seeds demonstrated in ryots' holdings. On an average over 90 such plots are being handled every year. New strains are however compared in regular trial plots for two or three years and the best ones are then multiplied and distributed. Propaganda and demonstration were also conducted by means of agricultural exhibitions at the time of festivals. Ten such exhibitions are being held annually in this circle. Wherever possible, specimen crops are grown on exhibition grounds. Agricultural Exhibition Vans are being taken round to important centres on the main highways. Another method initiated for propaganda and demonstration is the formation of Taluk Agricultural Associations. These were opened at Nandigama (Kistna district), Gurazala (Guntur district) and Kothapalem (Nellore district). The improved methods suggested by the department are being demonstrated in the holdings of the members of the society for others to follow.

Manures.

199. The work on manures consisted in the introduction of green manure crops in wet and garden lands, demonstration of the use of concentrated manures like bonemeal, fish guano, oil-cakes and chemical fertilizers. Depending on the nature of the soil suitable green manure crops like *vempali* for light soils, *dhaincha* for alkaline soils, sunnhemp and *pillipesara* for heavy soils, were introduced. Wherever possible bonemeal and fish guano (for paddy crop in particular), chemical fertilizers in combination with organic manures like cakes, farm yard manure and green manure were introduced. The benefits from the use of these combinations were

demonstrated in ryots' lands. When paddy was selling at Rs. 80 to Rs. 120 per *putti* (2,210 lb.) it paid the ryot to go in for concentrated manures. In 1924 the application of fish guano gave a profit of Rs. 30–50 per acre. Later on the supply of fish guano became limited and the use of chemical manures was in full swing during the years 1928 to 1930. With the fall in the price of paddy later on, it did not pay the ryot to use concentrated manures. The work was then confined to the acceleration of the spread of green manure crops, introducing improved methods in the conservation of cattle manure and converting the organic waste into useful synthetic manure. The use of green manure in combination with bonemeal was finally found to be the most economical even when the price of paddy has come down to Rs. 30 per *putti*. On the average about 20,000 lb. of green manure seeds are sold departmentally every year. The supply of other manures is being arranged on order. For the last two years attempts are being made to manufacture poudrette in co-operation with the Guntur Municipality. This should meet the heavy demands for manure in suburban areas.

Implements.

200. Improved iron ploughs suited for both heavy and light soils and for wet land soils were originally introduced into the circle. These were undoubtedly efficient but their cost was against their rapid spread. The ryot appreciates their efficiency but his economic condition militates against their universal introduction. With the advent of the cheaper Indian made Cooper's ploughs and the facilities offered in the shape of loans to be advanced for such purchase by the officers of the Agricultural Department, two favourable factors helped in the spread of such implements. During the last two years over 700 implements and 280 spare parts were supplied through the departmental help, not to mention those supplied through private agencies. Besides ploughs, other useful implements like the Hilson-Munro Guntaka, the chaff cutter, and the roll-easy mhote wheel have been introduced with success. Needy cultivators have been helped with advances which totalled to nearly Rs. 900 in 1934.

Pests and Diseases.

201. One of the common diseases of *jonna* is "smut." In the year 1928 a successful anti-smut campaign was begun in the Atmakur taluk of the Nellore district, the seeds being soaked in a solution of copper-sulphate. This practice was afterwards introduced in the Guntur and Kistna districts. In the year 1932 sulphur powder treatment against smut came into use. Since then the treatment has become very easy and during the last two years 4,300 packets of sulphur powder were supplied to the ryots, and thus the seed required to sow nearly 17,000 acres was treated against smut. The thrips pest on the chilli crop made its appearance so far back as 1926. A practicable and economic treatment was found

out at the Agricultural Research Station, Guntur, and it is as follows. The seedlings are first dipped in tobacco decoction and transplanted. About a month after that, fine tobacco powder is dusted on the crop in the dewy mornings. This is repeated once or twice at intervals of about a month. The thrips are thus kept under check and the crop thrives. This treatment is being tried on a field scale in ryots' lands during this year. Damping off is a severe disease on tobacco nurseries. Several methods of control like sterilizing the soil by burning trash, sowing seed on raised seed beds with adequate drainage facilities, spraying of Bordeaux mixture, etc., are under trial. In 1933 it was noticed that the disease was less virulent in the plots treated as above. During the years 1931 to 1933 water hyacinth made its appearance in the Kaikalur taluk (Kistna district) and Bapatla taluk (Guntur district). The Pest Act was put into force in time and the trouble nipped in the bud. Other minor pests and diseases like the swarming caterpillar of paddy, collor rot and gummosis of fruit trees are attended to by the Entomology and Mycology Assistants stationed at Guntur as and when need arises.

(c) The Bellary Circle.

The Third Circle.

202. The third (Bellary) circle comprises the districts of Bellary, Anantapur, Cuddapah and Kurnool. The establishment of the circle consists of a Deputy Director of Agriculture with headquarters at Bellary, two Assistant Directors of Agriculture with headquarters at Bellary and Kurnool. The Assistant Director at Bellary is in charge of the districts of Bellary and Anantapur, and the Assistant Director at Kurnool of the districts of Kurnool and Cuddapah. There are Superintendents to the Agricultural Research Stations at Hagari (Bellary district) and Anantarajupet (Cuddapah district). An account of the fruit station just started at Anantarajupet is given in the chapter under fruits. In addition to these two stations there is a third Agricultural Research Station at Nandyal in the Kurnool district. There are twenty-one Agricultural Demonstrators and thirteen demonstration *maistris* in the circle. Sixteen taluks are without demonstrators.

The total area under cultivation in this circle is 7,956,000 acres. The acreages under the chief crops are, millets—4,230,000, oil-seeds —1,569,000, cotton—881,000, pulses—717,000, paddy—310,000 chillies—42,000 and sugarcane—11,000.

The Famine Area.

203. This circle consists of districts having the lowest rainfall in the presidency. This low rainfall is very often badly distributed. The failures of rain are sometimes so severe that there is not enough drinking water. There is very often no demand for labour and the harvests are often insufficient for the next year's seed. This constant failure of seasons is a serious handicap in popularizing

agricultural improvements. On experimental farms the vagaries of the season affect the trend of the significance of the experiments in progress.

The circle is largely of black cotton soil. The principal crops are sorghum, groundnut and cotton. Millets occupy about half the area in the circle. Irrigated crops occupy an insignificant area. Individual holdings in Bellary and Anantapur average about 25 to 30 acres and the cultivation is usually carried on by the owner under the ryotwari system. In the Kurnool and Cuddapah districts an average holding is 10 to 15 acres.

Improved Cotton.

204. The crop that has been receiving attention for a number of years is cotton, the premier industrial crop of the circle. The main items of work are the evolution of heavy yielding strains of superior cotton, the production of seed of such improved cotton on contract with the ryots and its stocking and sale to the public from depots in the villages. Cotton seed of good quality of the superior strain H. 1, is produced and sold on a large scale annually, at times the quantity exceeding 2¾ lakhs of pounds sufficient to sow over 25,000 acres. By such means fresh seed is continually sent out. If natural spread is taken into consideration, it is estimated that cotton strain H. 1 is grown on 230,000 acres annually. In 1922 the area under improved cotton in the Bellary district was only 12,000 acres. The yiled of *kapas* of H. 1 cotton is higher than that of the local crop by about 10 per cent. The proportion of lint to *kapas* is about 30 to 31 per cent compared with a ginning percentage of only 23 in the local cotton. The lint is of superior quality and fetches a premium of Rs. 10 to Rs. 15 per bale of 400 lb. over the local cotton. In a normal year a gain of about Rs. 2½ is obtained per acre. This improved strain has thus contributed to the enrichment of the cotton cultivator to the extent of over 5 lakhs of rupees per year.

Millets.

205. Millets are the predominant cereals of the circle. Of these *jonna* is the most important. In the Bellary area which is part of the Deccan plateau, the important variety is the white grains *tella jonna*. In the Nandyal valley and the adjacent tracts which are lower in elevation, the chief variety is the yellow grained *patcha jonna*. In the Bellary area *tella jonna* strain T-1 continues to spread. Its natural spread is over several thousand acres. Continuous waves of fresh seed are always being sent out from the Hagari station. For the Kurnool area *patcha jonna* strain No. T-6 is spreading widely. It is estimated to cover an area of about 21,000 acres. Two other strains N. 28/3 and N. 29/68, superior to T-6 are being given out, about 12,000 lb. of seed in each having been distributed in 1934. Work on the improvement of *Korra*, the Italian millet, has begun at both Hagari and Nandyal stations.

Paddy.

206. The spread of the excellent cosmopolitan variety of paddy, viz., G.E.B. 24 has been greatly developed in recent years. It is now grown on about 16,800 acres. Fifteen years ago the area was insignificant. This introduction is estimated to enhance the return by Rs. 6 per acre and thus tend to a gain of over a lakh of rupees even from the small area under paddy in the circle. Economic transplantation of paddy is now practised in an area of over 8,000 acres and has resulted in a gain of Rs. 40,000 to the cultivators, working out at Rs. 5 per acre.

Sugarcane.

207. The newly opened sugar factory at Hospet has given a considerable impetus to improvements in the cultivation of this crop. Departmental advice was sought and given regarding suitability of land, the trial of varieties, the proper planting seasons and tillage. In co-operation with the Public Works Department, a plan of work has been decided upon for the conduct of irrigation experiments on land under the control of the factory. The local variety is *Pundia* which is late and liable to disease. In comparison with it Co. 281 is early and crops well. This has done well in several places. Other varieties are under trial. A wider spacing of the setts in the row has been advocated and this practice is gaining ground in Bellary and Kurnool districts. Ninety-nine improved Scindhewahe furnaces are in use.

Fruits.

208. During the past fifteen years educated persons have realized increasingly the importance and value of fruit as an article of diet. The necessity for curtailing the import of fruit which can be grown in the country is also being recognized. In consequence, an almost entirely new line of work has developed in advising on the planting and management of fruit gardens. In the Rajampet taluk of the Cuddapah district alone there are several thousand acres of valuable fruit gardens. The main items of improvements over local practice concern—(i) change in the method of laying out the land for irrigation which helps largely to control the main fungoid and virus pests of citrus, (ii) correct pruning which also helps to control diseases, (iii) inter-cultivation, (iv) manuring and (v) insect control. Recently about 11,000 fruit trees have been brought under some, if not all, of these improvements. Pruning implements have been sold on an increasingly large scale.

Storage of Farm Yard Manure.

209. A good part of the valuable constituents of farm yard manure upon which the ryot is dependent for good crops is lost on account of unsuitable methods of storage and collection. Under

present circumstances, therefore, large quantities of artificial manure are imported into the country for use, partly in replacement of such losses. The step to be taken to maintain the quality of farm yard manure is prevention of evaporation of urine which may be achieved by methods adapted to village conditions and within the reach of all villagers. The methods are well known in China and are fundamental in the production of food for her vast population. In one year, it has been possible in the Ceded districts to obtain the co-operation of the ryots in maintaining over 2,800 manure pits whereby improvement in the quality and quantity of manure has been effected in some measure. The intensifying of this work would have far reaching effects on crop production. This is almost an entirely new line of work which has been introduced in recent years.

Artificial Farm Yard Manure.

210. During the past fifteen years much knowledge has been gained concerning the role of bacteria and fungi in the decomposition of such waste material as weeds, groundnut husk, cholam stubble, and cotton stalks. As a result, it is now possible by the use of the kind of bacteria found in cattle urine to innoculate such waste material and to make good farm yard manure artificially. Similarly, by the use of the bacteria present in night soil, village rubbish and sweepings are converted into high grade manure. This new line of work is being developed in co-operation with the department of Public Health. Last year the Bellary Municipality manufactured about 175 tons of compost. The ryots prepared artificial farm yard manure in 64 different localities. The methods are simple and suited to village conditions. There is almost unlimited scope for development of this work which will have far reaching effects not only on public health, but on one of the main difficulties of the ryot, viz., an increase in the supply of manure.

Green Manures.

211. Other activities concern the manuring of wet land. Large quantities of green manure seed are stocked annually in Government depots. In 1935, 13,000 acres were under green manure crops in the circle. Fifteen years ago the area under this improvement was reported to be 500 acres only. A conservative estimate of increase in yield of paddy by green manuring is about 15 per cent or at present prices Rs. 1–8–0 per acre.

Improved Implements.

212. Under cultural improvements mention may be made of the trial of iron ploughs. These implements are manufactured by different firms and vary in quality of material, soil penetrating power, output of work, and ease of manipulation. The difference in the case of handling between a first-class implement and a cheaper one far exceeds the difference in price. It is therefore necessary to compare one plough with another in the light of the

ryots' requirements and resources in order to give him the very best value for his money. This is done by means of trials of one plough against another.

Apart from ploughs, there are other implements and machines, the materials and performances of which need to be tested before they can be recommended to the ryots. For example, the provision of a more efficient seed drill for cotton is important, and on account of the peculiar qualities of the soil in the Bellary district such trials have to be conducted locally. New bund forming implements and harrows have also been under trial on the stations, as a result of which it has been possible in co-operation with the Research Engineer to design implements suited to local conditions. The ryot is now able to acquire a bund forming implement at a low cost and suited to his soil.

In assisting the public to choose efficient agricultural machines and implements, another line of work is the erection of water-lifts for demonstration purposes. This is carried out on private holdings. The manufacturers of such machines co-operate with the department for this purpose without expense to the State, and it is only by such means that the public are able to see the performance of a machine before purchase.

There were nearly a thousand demonstrations of improved implements in 1934. The average number of improved ploughs sold per year comes to nearly a hundred, there being a record sale of 260 ploughs in 1925. These last a long time, and wearing parts will require renewal now and then.

Disease Control.

213. Diseases take a heavy toll of the ryots' crops which amount to several lakhs of rupees per annum. A specially qualified assistant is on the establishment of the circle who conducts experiments in spraying, dusting with poison, and other remedial measures in the control of insect and fungoid pests. He answers calls received from the public for assistance in the control of pests. This is an entirely new work which has developed during the past ten years. In addition to such work he carries on experiments in apiculture.

Hagari Research Station.

214. At the Hagari Agricultural Research Station the outstanding item of work in recent years has been the improvement in the methods of dry-farming by which the maximum use is made of the poor rainfall of the tract. For example, it has been shown in the adjacent areas of the Bombay Presidency where the total rainfall is much the same as in the Bellary district, that as much as fifty per cent of the rainfall may be lost to the crop on account of the run off, evaporation by the sun, and other causes. At Hagari, it has been possible to control the run off of rain water by the erection of small bunds, the cost of which is less than that of ploughing. By

such means it has been possible on an experimental basis to raise the yield of cotton substantially.

Apart from cultural improvements, the station is largely devoted to the improvement of cotton, *jonna*, *ragi*, *korra* and groundnut. A strain of cotton called H. 1 which was isolated on this station is being grown on increasingly large areas in recent years. As a result of experimental work, a strain of *ragi*, evolved by the Millets Specialist at Coimbatore, viz., E.C. 593, has been found to be superior to the local crop, the difference in yield amounting to about 20 per cent, the value at present prices being about Rs. 2-8-0. A new strain of *korra* shows promise in yield compared with the local seed.

A particularly large type of onion is grown in Bellary under the name of Bellary onions. Its cultivation is very profitable and it has sometimes given Rs. 650 worth of seed outturn per acre. There is a large demand for the supply of seed from various parts of the presidency and this is met by crops raised at Hagari.

Nandyal Research Station.

215. The Research Station at Nandyal is primarily devoted to the two important crops of the tract, viz., *jonna* and cotton. The strain of *jonna* No. 28/3 isolated by the Millets Specialist and compared with the local crop, has given over a period of three years an average increase in grain yield amounting to about 28 per cent. The seed of this strain is being distributed. Spacing experiments of *jonna* have brought out the fact that differences in yield of grain between close sown and wide sown plots is not significant. Wide sown plots gave bigger earheads fewer in number. In the case of straw, however, the closer spacing gave progressive and significant increase with seed rate. This increase is more than sufficient to compensate for the higher seed rate used. The cotton from this tract is commercially known as the " Northerns." N. 14 is the improved strain of this cotton. Cotton is grown on lands that had *jonna* the previous year. Manurial experiments conducted at the station go to prove that manuring cotton directly is not so advantageous as manuring the *jonna* preceding it. The cultivation of groundnut is increasing. By experiment it was determined that when cotton and *jonna* are grown in rotation with groundnut there is a better response to manuring in general on the part of both *jonna* and cotton. In addition to this a marked increase in the yield of *kapas* has been obtained, over the normal two-course rotation of *jonna* and cotton.

(*d*) The Chingleput Circle.

The Fourth Circle.

216. The fourth (Chingleput) circle consists of the districts of North Arcot, South Arcot, Chingleput and Chittoor. The circle is in charge of a Deputy Director of Agriculture with headquarters at

Saint Thomas' Mount. There are two Assistant Directors of Agriculture, one for the South Arcot and Chingleput districts with headquarters at Cuddalore, and the other for the North Arcot and Chittoor districts with headquarters at Vellore. There are 25 demonstrators for the circle and 14 demonstration *maistris*. There are two demonstrators one at Cuddalore and the other at Tirukkoyilur to attend specially to marketing groundnuts. There are two other demonstrators trained to tackle crop pests and diseases when they break out. Under the Deputy Director of Agriculture there is an Agricultural Research Station at Palur near Nellikuppam in the South Arcot district and a demonstration farm at Kalahasti in the Chittoor district. At Gudiyattam in the North Arcot district, an Agricultural Research Station was opened in 1935 for research on problems connected with the growing of sugarcane under lift irrigation. This station is under the Superintendent of the Agricultural Research Station, Anakapalle. The Agricultural Research Station at Palakuppam (South Arcot district) which was started in 1925 for work on oil-seeds, specially groundnut, gingelly and castor, was closed down in 1935 on the expiry of the ten years' lease and a new station was started at Tindivanam in 1935 to take its place. This station is under the Oil-Seeds Specialist.

The cultivated area of the circle consists of 4,845,000 acres. The acreages of the important crops are, paddy—2,023,000, millets—1,373,000, oil-seeds—1,024,000, pulses—171,000, mangoes—45,000, and sugarcane—24,000.

Paddy.

217. The main items of propaganda in the improvement of paddy are the introduction of improved strains, the raising of thin nurseries, the economic planting of seedlings, the growing of green manure, and the judicious application of concentrated and chemical manures. The value of the improvements effected in this all-round endeavour, on the paddy crop of the circle, can be claimed to be Rs. 15 per acre and the total monetary gain can be easily evaluated at about 13 lakhs of rupees. Nearly 30,000 lb. of departmental strains of paddy were sold direct to the cultivators in the year 1934 and from seed farms of nearly 250 acres in extent, 83,000 lb. of improved paddy seed were made available for distribution. The varieties popular in the circle are G.E.B. 24, Co. 2, and Adt. 2. Whereas in 1921 improved strains of paddy covered 2,000 acres only, in 1935 the area under this was about 91,000 acres.

Sugarcane.

218. Sugarcane is an important industrial crop in the circle. New types of sugarcane have been introduced, the noteworthy ones being Co. 213, Co. 281, J. 241 and Fiji B. These occupy an area of 20,800 acres as against the 1,800 acres under improved canes in 1921. Improvements in the cultural and manurial methods of growing cane have been demonstrated. The improved Sindhwahe

furnace has been introduced and is becoming rapidly popular. There were only 40 such furnaces in 1921. Their present number is 16,160. The saving to the sugarcane cultivator from the cumulative effects of these improvements can be set down to Rs. 30 per acre and works up to a gain of nearly 6 lakhs of rupees per annum for the circle.

Groundnut.

219. Groundnut is an important crop in this circle. It is grown in an area of about 889,000 acres. Its importance was recognized long ago and the Agricultural Research Station at Palakuppam was devoting its main attention to this crop. Several varieties both 'spreading' and 'bunch' have been tried. Selection and hybridization were resorted to. The variety, Gudiyattam Bunch, was found good and given out to the cultivators. Spacing and manurial experiments have been in progress. Intensive observations on the groundnut plant have been made. The work done at Palakuppam is being continued in the new station at Tindivanam. Strain No. A.H. 25 evolved by the Oil-Seeds Specialist has been found to do well both in the Cuddalore and in the Vellore divisions and arrangements were made to multiply the seed on ryots' land for distribution. In 1934, 1,220 lb. of seed were distributed. Being an important commercial crop it fetches ready money to the ryot. It was found that ryots were not getting full value for their produce, due to the fraudulent methods of a number of middlemen. In 1932 by the joint endeavours of the Co-operative and Agricultural departments, Co-operative groundnut marketing warehouses were started at important centres like Cuddalore, Tirukkoyilur, Vriddhachalam and Tiruvannamalai. The ryots were encouraged to sell their produce through these warehouses where they were given money advances for their immediate needs in case the produce need be held up awaiting better prices. In addition the ryots are given crop loans through co-operative societies for financing groundnut cultivation and these are adjusted at the time of the sale of the produce. The value of the produce sold each year has been progressively increasing as follows :—1932—Rs. 18,336; 1933—Rs. 68,561; 1934—Rs. 1,86,390.

Ragi.

220. There is a large area under *ragi* in this circle (438,000 acres), the two districts of Chittoor and South Arcot alone having 266,000 acres. E.C. 593, a strain of *ragi* evolved by the Millets Specialist, was tried in various places and has been a success. It has given an increase in yield over local *ragi*, varying from 8 to 45 per cent. This strain is in very great demand and nearly 1,300 lb. of seed have been distributed in 1934.

Other Crops.

221. Cambodia cotton is becoming very popular in this circle. About 8,000 lb. of seed of Co. 2 was distributed in 1934. Co. 7, a *Karunganni* cotton, was introduced in the dry lands. Advice in

regard to the selection of suitable fruit-trees like orange, mango, lime and coconut, their planting, pruning, manuring and control of pests and diseases was given. Nearly 1,200 grafts and seedlings have been supplied to orchard growers in 1934.

Green manures like *dhaincha*, sunnhemp, *kolinji*, Nandyal indigo, *pillipesara* and local indigo are advocated for paddy lands. About 58,000 lb. of seed were distributed in 1934.

Livestock.

222. Thirteen breeding bulls are maintained by the department in this circle. There are 14 other breeding bulls stationed in various places under the premium scheme. Better types of poultry have been introduced in several villages. Bee-keeping as a useful cottage industry has been widely demonstrated.

The Red Hairy Caterpillar.

223. Dry crops like groundnut, *cumbu*, etc., are subject to the attack of a serious pest known as the Red Hairy Caterpillar. The enormity of the pest can be judged from the fact that a marching column of these insects kept a railway train at bay for more than one hour near Vriddhachalam. To control this pest the Pest Act has been in force for the last five years and a large staff of demonstrators and maistris are deputed to this tract to educate the ryots to jointly adopt control measures by destroying the small number of cocoons and moths so that its further multiplication may be stopped. This has considerably reduced the damage by the pest.

Palur Research Station.

224. At the Research Station, Palur (5 miles from Nellikuppam R.S.), the chief crops dealt with are paddy and sugarcane. Selection in paddy varieties *Chitrakali*, *Swarnavari*, *Garudan Samba* and *Seevan Samba*, is in progress. Several semi-dry paddy varieties are being tried, of which *Vadan Samba* has been found to be the best. Experiments are being conducted to find out the manurial requirements of sugarcane. It has been found that sugarcane responds to heavy manuring up to 200 lb. of nitrogen per acre and that it was best to apply the manure in three doses during the growth of the crop. By a rotational experiment it was found that growing cane once in three years, and rotating it with other paying crops like groundnut, *ragi* and plantain is the best. Varietal trials of groundnut are in progress. A medicinal plant, *Vasambu* (Tamil) the sweet flag, *Acorus calamus* has been tried in wet lands with success. It has given a net profit of Rs. 90 per acre. There are commercial possibilities of its systematic cultivation in reclaimable swamps. *Korai* control investigations have established the fact that the frequent working of H.M. *guntaka* in fallow fields and picking the nuts were helpful in checking the growth of this weed. It was also

observed that garden land paddy, sugarcane and fodder crops prevent the rapid multiplication of this weed. A large flock of poultry is reared on the farm, consisting of White Leg-horns, Rhode Island Reds and Light Sussexes. A day school for labourers' children and a night school for the adults are being run for the benefit of farm labourers.

Schoool Farm, Kalahasti.

225. Started in the year 1925 as the centre of an Agricultural Middle School, through the munificence of the late Raja of Panagal, the Kalahasti School Farm is at present running as a small general purpose station. The lands are sandy and alkaline in patches and have been reclaimed by the carting of tank silt, the growing of green manure crops and the provision of underground drainage channels. The usual wet, garden and dry land crops are grown and a few fruit-trees have been planted. Poultry keeping as a cottage industry is being demonstrated and a small pen of Rhode Island Reds is being maintained. With the giving up of the idea of starting the middle school, the future of the station is under consideration.

(e) The Trichinopoly Circle.

The Fifth Circle.

226. The fifth (Trichinopoly) circle comprises the two districts of Tanjore and Trichinopoly. The Deputy Director of Agriculture in charge of this circle has his headquarters at Trichinopoly. There are 17 agricultural demonstrators and 10 demonstration *maistris*. Arantangi is the only taluk without a demonstrator. The circle has two Agricultural Research Stations in it. The one at Aduturai is in charge of a gazetted Superintendent. The other Agricultural Research Station is at Pattukkottai, in the Mettur irrigation area. In 1922 there were only nine agricultural demonstrators, and the work was confined to the Cauvery delta in the Tanjore district and the Cauvery basin of the Trichinopoly district. With the increase in demonstrators, the other drier areas of the circle have been brought into the sphere of the demonstrators' activity.

The cultivated area of the circle is 3,004,000 acres. The acreages of chief crops of the circle are, paddy—1,402,000, millets—923,000, oil-seeds—316,000, pulses—184,000, cotton—47,000, coriander—26,000, and plantain—21,000.

Soil Survey.

227. A soil survey of the Tanjore delta has been made by the Agricultural Chemist and the general manurial requirements of the tract ascertained. The major portion of the delta has been found to be deficient in nitrogen and phosphoric acid. This deficiency is in part met by the silt-laden irrigation water from the Cauvery.

The wet lands in the Trichinopoly district seem also to be deficient in nitrogen and phosporic acid as they respond readily to the application of these manures.

Scheme of Improvements.

228. The following improvements suggested themselves after a careful study of the local conditions and agricultural practices of the tract (i) to reduce the seed rate and planting of seedlings in twos and threes instead of in bunches, (ii) to find out better yielding strains of paddy that would mature uniformly and that would not lodge during heavy rains, (iii) to introduce industrial and money crops like sugarcane, plantain, turmeric, etc., (iv) to find out cheap and efficient methods of improving the physical texture of heavy soils, (v) to introduce better methods of collection and conservation of cattle manure, thereby improving its quality and increasing the quantity, (vi) to introduce cheap and effective nitrogenous and phosphatic manures, (vii) to introduce suitable artificial and concentrated manures which can replace and supplement cattle manure which is generally applied to the *Kuruvai* crop only in double-crop lands, so that the cattle manure thus saved may be applied to the single-crop lands, (viii) to introduce cheap iron ploughs and other implements and appliances such as seed drill, mhote wheel, and chaff cutter. With these objects in view a series of experiments were conducted at the Manganallur Farm (opened in 1912 and closed in 1922) and the results of these experiments were the basis for the lines of district work in the circle.

Methods of Propaganda.

229. The several methods adopted for the diffusion of agricultural improvements among the ryots are—(i) Meeting individual ryots in their villages and speaking to them about agricultural improvements and demonstrating such improvements to them in their own lands as far as possible. (ii) Holding of agricultural exhibitions during important festivals and explaining to the visitors, the several improvements effected, and doing propaganda with the aid of the touring Motor Exhibition Van. (iii) Addressing ryots on agricultural improvements during *Jamabandi* camps, Co-operative meetings, and other gatherings. (iv) Holding of ryots' conference in Government Farms. (v) Distributing leaflets, calendars and other publications. (vi) Running demonstration plots in ryots' lands, in central villages at their expense but under the supervision of the Agricultural officers. (vii) Starting of Co-operative Agricultural Societies and making them run demonstration plots and stock and distribute seeds, manures and improved implements.

The Co-operative Method.

230. Every one of the above methods has its own merit but the one mentioned last is admittedly the surest and the most efficient. The ryot who is conservative all over the world will believe nothing

but what he sees with his own eyes. The co-operative method provides sufficient scope for ocular demonstration and the results are found very satisfactory. For instance at the Lalgudi Sivagnanam Co-operative Agricultural Society, Ltd., in the second-crop season of 1925–26, an ocular demonstration of each of the improvements advocated for paddy was tried as against the local practice, individually and collectively and the following figures recorded by the society carried an abiding conviction to the cultivators of the tract, about the improvements advocated. Selected seed gave an enhancement of Rs. 35 as against local seed. Economic planting gave a gain of Rs. 11 over bunch planting. The application of phosphatic manures increased the yield by Rs. 33 per acre when compared with the local manuring. Deep ploughing had Rs. 9 in its favour as against shallow ploughing. In the experiment in which all the four improvements given above were tried together, the gain over corresponding local methods was Rs. 40.

Paddy—Reduction in seed rate.

231. As a result of effective propaganda from 1910 onwards there was a considerable reduction in the quantity of seed used per acre and it stood at 24 Madras measures for *samba* against 48 M.M. and 36 M.M. for *kuruvai*, as against 54 M.M. in 1922. The intensive propaganda in this direction was continued with good results. It can be claimed that this practice has permeated practically the whole of the area, the seed rate adopted varying round about 12 M.M. Sowing thinly in the nursery at 1½ M.M. in one cent of land and planting economically in twos and threes results not only in the reduction of seed, but the resultant vigorous crop brings in an extra income of about Rs. 20 per acre. Thus economic planting enhances yield. The saving in seed brings in an additional gain which enables the cultivator to manure his lands that are usually left unmanured.

Paddy Strains.

232. At the time when the Popular Account of the Department was written in 1922, G.E.B. 24, R.S. 76 (Red *sirumani*—Adt. 1) and mass selected seed of the *Nellore samba* from the Manganallur farm were the only seeds that were being distributed in both the districts. With the abolition of the Manganallur Farm in 1922, the breeding work done there was continued by the Paddy Specialist at the Agricultural Research Station, Aduturai, which was opened in the same year. The whole of the Trichinopoly district (Cauvery valley) and the western portion of the Tanjore district, i.e., Tanjore and Papanasam taluks and a portion of Kumbakonam taluk where the soil is generally loamy and well drained, *Nellore samba* is the main *samba* variety, while *sornawari* (Sarapalli) and *kuruvai* are the first crop varieties. In a portion of the Kumbakonam taluk and the northern and eastern taluks of the delta where the soil is heavy, the main varieties are red and white *sambas*. Of late, however, ***korangu samba***, otherwise known as *kattai samba* has gradually

replaced white and red *sambas* in the eastern taluks. In the eastern portion of the delta, *kuruvai* is not grown as a pure crop but as a mixture of *kuruvai* and *ottadan* known as *udu*. Thus it will be seen that the chief strains of paddy required for the tract are red and white *sambas, kuruvai, ottadan, Nellore samba* and *kattai samba*. The Aduturai Farm which was opened chiefly to cater to the needs of the circle was able to evolve and release strains for all varieties except *kattai samba* within three or four years of its existence. A high yielding strain of *kattai samba* was however released in 1932. All the strains are noted for their uniform maturity, high yielding qualities (10 to 15 per cent more than the local seed) and freedom from red rice. There has been a steady increase in the area under improved strains. From 7,000 acres in 1922 it has risen to 3½ lakhs of acres in 1935. The total gain by this one improvement leaving apart improvements like economic planting and the application of artificial manures, is over fourteen lakhs of rupees per year, estimating the gain at Rs. 4 per acre.

The System of Seed Multiplication and Distribution.

233. Before multiplying and distributing the strains on a mass scale, care is taken to give the strains trials in small areas in ryots' lands under ryots' conditions. Measures are taken to multiply the seeds and distribute them only when they are found to satisfy the local conditions. From 1919 to 1924, seed-farms were the only media for the multiplication and distribution of select seeds. This system of seed distribution though good and useful in itself, involved a good deal of work for the demonstrator in connexion with the drying, stocking and selling the seed which extends over a long period in the year. Further, it was not possible to handle a very large quantity in this way when the demand for good seed increased. To meet the increased demand the following means were adopted :—(1) Supplying to select individual ryots and Co-operative Agricultural Societies in good centres with fresh seed every year, on condition that they distribute at least 50 per cent of the produce for seed purposes. (2) Inducing Village Panchayats and Co-operative Credit Societies to run seed farms of their own to meet the requirements of their members.

Thus the seed from Aduturai served as the nucleus for multiplication and was just sufficient for distribution to the institutions and individuals who had agreed to aid the department in the work of supplying pure strains of seeds to ryots. After a few years of satisfactory work, Co-operative Credit Societies and Panchayats ceased to function; so also some of the Co-operative Agricultural Societies. The system of supplying fresh seed every year to individual ryots and their distribution of the 50 per cent of the produce for seed purposes has proved a success justifying the continuance of the same. The rapid spread and the maintenance of the purity of the strains in this circle must be attributed to this system. It is not an easy task to gather statistics of the area under our strains but the fact

that it was not possible to get a small quantity of the local seed for comparison with the strain shows that the local seed has been almost completely replaced by the respective strains except *kattai samba* and other coarse varieties for which strains have not been evolved. As regards *kattai samba*, the strain evolved in 1932 is being distributed and the area under this is at present about 6,000 acres. The quantity of paddy seed distributed by the department and other agencies every year rose from 50,000 lb. in 1922 to 2 million pounds, the average of the last six years.

Manures.

234. The common manures consist of farm yard manure, house sweepings, ashes and tank silt. Cattle and sheep penning are also practised. This is sufficient for a portion of the cultivated area only. There are not very many facilities for securing green leaf, there being few forests. The cost of bringing leaves from outside is very prohibitive apart from the trouble and labour involved. With the phenomenal fall in the price of paddy, the chief aim of the department has been to reduce the cost of cultivation of paddy and increase its output. This aim precluded the encouragement of the use of chemical manures on a large scale. The ryots are hence being advised to increase and improve their cattle manure by paying better attention to its preservation by adopting one of the improved systems, viz., loose-box, dry earth or byre and to see that urine—the important manurial ingredient—is not wasted and that the collected manure is conserved in pits protected from sun and rain. The ryots are also induced to compost all waste materials available with cattle dung and thus augment their supply of manure.

At a cost of Rs. 2 to Rs. 3 per acre, green manure crops can be grown *in situ* and puddled in as manure. Every help is rendered to the ryots in supplying or procuring the several green manure seeds required. The chief green manure crops grown are *kolinji*, sunnhemp, indigo and *dhaincha*. Nowadays merchants also stock these seeds for sale. Green manure crops improve the texture of the soil also. The quantity of green manure seed distributed by the department will average about 62,000 lb. annually. The area under green manure crops will on an average be about 18,000 acres.

The results of the experiments at the Manganallur farm showed that an application of bonemeal or Trichy-phosphate to paddy lands in conjunction with green leaf is the cheapest and most effective method of manuring and the ryots are being advised accordingly. In the application of chemical manures, ryots are instructed to use them only in conjunction with bulky organic manure lest the fertility of the soils be adversely affected.

Experiments conducted with the application of chemical manures in conjunction with bulky organic manure have proved in many cases that the gain over the local method of manuring may range from Rs. 14 to Rs. 26 per acre.

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Cash Crops for Wet Lands.

235. With the fall in the price of paddy in 1930 and the comparatively low yields of paddy in the delta, the question of advocating the growing of new and profitable crops had to be thought of. It was to solve this problem that the Aduturai farm, a purely Paddy Breeding Station prior to 1930, was converted into a general utility farm and remunerative crops like sugarcane, plantain, turmeric, etc., are being tried in wet lands with favourable results. These results are being brought home to the ryots and there is a fair response from them. In the Tanjore delta there is at present an area of 114 acres of sugarcane where cane cultivation was not known before and 59 acres under plantains. In the Trichinopoly district, J. 247 and Fiji B have almost replaced the local reed canes grown for manufacturing jaggery. The main difficulty in the rapid spread of sugarcane in the delta is the question of its disposal. Ryots who have been accustomed to the easy cultivation of paddy are reluctant to take to the more tedious industry of jaggery manufacture. If there is a sugar factory in a good centre the area under cane is bound to increase rapidly in the delta. Groundnut as a first crop to be followed by paddy in wet lands is likley to prove successful.

Sugarcane.

236. The chief varieties of cane commonly cultivated are the reed cane and '*nanal*' which are poor yielders. Before 1923 there were practically no improved varieties of sugarcane in this circle. Setts of J. 247 and Fiji B sufficient for two acres were got from Gudiyattam farm and supplied to a few ryots in Trichinopoly, Lalgudi and Tanjore taluks, with a view to replace the local variety. The present area under the improved varieties of cane is nearly 1,500 acres. Their introduction has resulted in a gain of over a lakh of rupees to the sugarcane cultivators, calculating at Rs. 75 per acre. As these varieties took nearly 12 months and more to mature and as they were found not quite suitable to withstand drought and water-logging, thin Coimbatore canes of short duration (9 to 10 months) were tried both on the Aduturai farm and in ryots' lands with fair success; they are being introduced in the circle for the last two years. The present area under these varieties is 25 acres. Side by side with the introduction of the improved varieties, cultural and manurial improvements and better methods of preparing jaggery are being advocated. In the last two years, the preparation of cream jaggery by the use of activated charcoal is being demonstrated.

Plantain.

237. Plantain is one of the important money crops grown largely in the wet lands of the Trichinopoly district and in a portion of the Tanjore taluk bordering the Trichinopoly district. With the fall in price of paddy, ryots in other taluks were advised to grow plantain

in wet lands and the area is increasing gradually. The disease of plantain 'wilt' was found to be spreading in the Trichinopoly district and damaging the crop. Necessary steps were taken to check the spread of the disease by advising the ryots to plant healthy suckers only. New varieties got from Coimbatore were introduced in both the districts. In the cultivation of this crop, about Rs. 100 to Rs. 150 are spent in manuring an acre. Cattle manure, pigs' dung, village sweepings, etc., are the manures that are generally applied. Trials in ryots' lands show that half the dose of the above manure *plus* green manure (grown *in situ*) and about 2 cwts. of bonemeal, not only minimizes the cost of manures, but increases the size of the fruits. Bunches from fields that have been manured according to the departmental advice fetch 2 annas more each. This system of manuring is extending gradually.

Millets.

238. *Cholam*, *ragi*, and *cumbu* are cultivated on a fairly large area in the Trichinopoly district. Of the five strains of *cholam* supplied by the Millets Specialist during 1934, A.S. 367 and A.S. 1543 proved satisfactory, and the trials will be repeated for one or two years more. E.C. 593 *ragi* fared well in many places and arrangements are being made to multiply and distribute the strain.

Cotton.

239. Cotton is another important cash crop in the Trichinopoly district. Cambodia cotton occupies nearly half the area under cotton while the other half is under *uppam* and *nadan*. The two latter are inferior varieties and fetch low prices. To replace these, C. 7 *karunganni* from Kovilpatti was introduced and at present it covers an area of 538 acres. Cambodia cotton strain C. 2 of Coimbatore was introduced and the area under the same is nearly 2,300 acres. The demand for this seed is increasing every year. The introduction of these improved strains has meant a gain of Rs. 10 per acre. Along with the introduction of strains, sowing in lines was advocated. This system, besides reducing the cost of after cultivation, facilitates the picking of *kapas*. Trials are in progress at the Agricultural Research Stations, Aduturai and Pattukkottai, to see if Cambodia cotton can take the place of the second crop of paddy in double-crop wet lands.

Groundnut.

240. Groundnut is grown in the red and sandy soils of the circle both dry and irrigated. Improved varieties like Gudiyattam Bunch, A.H. 25 and H.G. 1, were introduced and are becoming popular. The yield of the strains is nearly 20 per cent over the local varieties. It is likely that these strains will spread rapidly.

Coconut.

241. Every year a good number of coconut seedlings and nuts are got from the coconut stations on the West Coast and from the Muthupet area and distributed to the ryots in the circle. The chief improvement advocated is the inter-cultivation of gardens as often as possible to keep them clean and free from weeds. Another improvement is the application of bonemeal in conjunction with green leaves as manure to the trees. A third improvement is the planting of seedlings at a distance of not less than 25 feet each way. The ryots after their bitter experience of close planting are adopting this departmental advice in their new plantations.

Fruit Trees.

242. Mangoes, citrus, and jack are the important fruits of the circle. The tendency to take to the planting of fruit trees is gaining strength and the area under them is increasing year after year. At the instance of the department 4,600 mangoes, 650 citrus plants, 150 sapotas and 180 guavas, figs and grapes and over 1,200 pine-apple suckers were supplied to the ryots during the last three years.

Fodder Crops.

243. To supplement paddy straw, ryots are advised to grow guinea and elephant grasses and raise fodder *cholam* and to that end grass slips and *cholam* seeds are distributed. These fodder crops supply the much needed green feed for the livestock.

Pests and Diseases.

244. Assistants in Entomology and Mycology are stationed at Aduturai to attend to the calls of the ryots of the circle in combating pests and diseases. The Pest Acts on cotton and groundnut are in force in the Trichinopoly district and that on the Water Hyacinth, in portions of the Trichinopoly district and in the whole of the Tanjore district.

Implements.

245. The only agricultural implement of the tract worth mentioning is the light country plough. By successive demonstrations of the utility of light iron mould board ploughs, it has been possible for the department to convince even the most conservative ryots of the benefits of this improvement. Though progress in this line of improvement is slow, it is not discouraging.

With the introduction of Special Loan Rules for the mass distribution of improved implements, there is a great response on the part of the ryots to avail themselves of the opportunity to purchase iron ploughs and other improved implements. The grant allotted to the circle was spent completely during the last three years

and there are at present over 2,500 iron ploughs at work. Their introduction has resulted in a greater efficiency in tillage and the estimated gain by their use is easily Rs. 5 per acre. In addition to iron ploughs, the utility of such efficient and labour-saving appliances, as mhote wheels, chaff cutters, seed drills, H.M. *Guntakas*, bund-formers and sugarcane mills, were actually demonstrated and a keen demand has been created for these with the help of the loan rules. The sudden increase in the purchase of these during the last three years clearly shows the low purchasing power of the ryots unless some special facilities like these are given to them.

Co-operative Organization.

246. Without the active help of public bodies like the Co-operative Agricultural Societies and Associations, the spread of our improvements would not have been rapid. To secure this end new Co-operative Agricultural Societies were formed and the old defunct ones revived. Special mention should be made of the Lalgudi Sivagnanam Co-operative Agricultural Society, Mulangudi Agricultural Society and the Tanjore Co-operative Agricultural Society. These Societies helped the department very much in conducting demonstration plots, seed farms and serving as agents for the distribution of pure seed, manures and implements. There are at present four Agricultural Societies in the Tanjore district and five in the Trichinopoly district doing useful work. Some of them keep stud bulls for improving the local breed of cattle. The Trichinopoly District Agricultural Association and the Tanjore Delta Mirasdars' Association are actively functioning.

Livestock.

247. The cattle in the circle are puny. They are poor in milk yield nor are they efficient work animals. To grade up the local breed, stud bulls are maintained by individuals and public bodies. At present there are 12 such bulls under the premium scheme.

At the instance of the department, many ryots have taken to apiculture and poultry farming, as a side line to agriculture. Over 25 bee-hives are at work.

Aduturai Research Station.

248. The Aduturai Agricultural Research Station was opened in the year 1922, purely as a Paddy Breeding Station, and continued to be such till 1930. During that period it had done very good work in the evolution of the paddy strains mentioned already and has contributed not a little to the wealth of the ryots of the Tanjore and Trichinopoly districts. Since 1930, the farm has taken up other lines of work also in connexion with different crops. Different varieties of sugarcane are grown and tested under delta conditions; plantains are being successfully grown in wet lands. Groundnut and maize are also grown in rotation with paddy. Soy

beans thrive well and extensive trials with many varieties are in progress. A vegetable section has been added recently. Besides the evolution of strains of these crops both by single-plant selection and hybridization, the farm is conducting cultural and manurial experiments on different crops. But for the opening of this farm in 1922 the purity and freedom from red rice of the Tanjore paddies could not have been achieved at all. Poultry farming on an extensive scale is in progress, a large flock of White Leg-horns, Rhode Island Reds, Light Sussexes, Black Minorcas and Chittagongs being reared. The grading of country birds with a view to increase their egg-laying capacity has been taken up.

Pattukkottai Research Station.

249. Long before the completion of the Grand Mettur Dam and that of the Grand Anicut Canal and its distributary systems, the Government had an idea of starting an agricultural farm in a central place for the new irrigation project area. Various sites were selected in different centres and finally the present site at Pattukkottai quite close to the town was chosen and the lands were handed over to the department only in February 1935. The area consists of 36 acres of dry, garden and wet lands, both single and double cropped.

The object of the station is to experiment in the growth of crops other than paddy with a view to demonstrate a system of cropping that will prove remunerative by taking water from the project channels for irrigation. Crops like sugarcane, plantain, irrigated groundnut, turmeric, and Cambodia cotton are being tried as rotation crops with paddy in single and double-crop wet lands.

(*f*) The Madura Circle.

The Sixth Circle.

250. The sixth (Madura) circle comprises the districts of Madura, Ramnad and Tinnevelly. The Deputy Director of Agriculture is at Madura. There are two Assistant Directors, one at Madura and the other at Tinnevelly. There is an Agricultural Research Station at Kovilpatti in charge of a gazetted Superintendent. There are 21 demonstrators in the circle and 15 demonstration *maistris*. Three taluks are yet to have demonstrators. In the earlier years the work of the circle was mainly on cotton and partly on paddy in the Periyar tract. With the posting of agricultural demonstrators in practically every taluk centre the work of the circle has developed in many channels.

The total cultivated area of the circle is 4,103,000 acres. The acreages of the main crops are—millets—1,361,000, paddy—1,082,000, cotton—627,000, pulses—290,000, oil seeds—236,000, fodder crops—128,000, chillies—43,000, plantain—27,000, and coriander—25,000.

Karunganni Cotton.

251. Cotton is a very important industrial crop of the circle and goes under the trade name of '*Tinnies*'. *Karunganni* is the vernacular name of the variety grown. Strains of this cotton evolved at the Agricultural Research Station, Kovilpatti, are under distribution. The present area under these strains due to the agency of the department as well as subsequent spontaneous spread can be estimated at about 1¼ lakhs of acres. The latest area under seed farms is 1,200 acres. The gain to the cultivators is substantial in that these strains have a longer and a finer staple, yield higher and gin better and thus fetch a higher price.

Formerly under the impetus of a premium, seed unions were undertaking the production and distribution of improved seeds. The value of improved seed has begun to be recognized and the premiums withdrawn. Co-operative Loan and Sale Societies have taken over this important item of work.

Concurrent with the distribution of better strains of *karunganni*, their sowing with the drill was also advocated. In 1922, the area sown under drills was about 6,400 acres. In 1934, this area had doubled. Drill sowing is economical in that it reduces after-cultivation expenses. The gain by this improvement per acre is calculated at Rs. 4 and the net gain by this one cultural improvement comes to nearly ½ lakh of rupees.

Cambodia Cotton.

252. The spread of Cambodia cotton in the circle is a feature of the progress in the cotton improvement during the last decade. Co. 2, an improved strain, has been introduced and is reported to cover an area of nearly 40,000 acres in 1934. The gain to the cultivators by its introduction is estimated at Rs. 14 per acre and amounts to nearly 5½ lakhs of rupees for the circle. The sowing of Cambodia cotton in lines is advocated and the saving effected in the cost of cultivation is an additional gain.

Paddy—Economic Planting.

253. In the paddy tracts of the circle the departmental propaganda in favour of thin sowing of seed-beds and economic transplanting of the seedlings has been carried on with considerable success during the last decade. The saving in seed and the increased yield consequent on the planting of fewer and better seedlings can at a conservative estimate be put down to be Rs. 3 per acre. There is an area of well over 60,000 acres under this improvement and the gain accruing to the ryots is well over 1½ lakhs of rupees.

Paddy—Green Manuring.

254. With the spread of the area under paddy the problem of manuring the paddy lands assumed importance. The old practice by which a few well-to-do ryots could transport green leaf by rail

at a heavy cost of Rs. 20 per acre is obviously an impossible situation. Intensive propaganda in favour of growing green manure crops on the land and ploughing them in was carried on with the result that the present seed supply consequent on a steady demand is largely in the hands of private seed suppliers. The area at present growing green manures is about 23,000 acres, mostly in the Periyar area and even at the most conservative estimate of Rs. 8 per acre, the gain to the cultivators through this item of propaganda is over 1½ lakhs of rupees per annum.

Paddy—Improved Strains.

255. The introduction of improved strains of paddy began with the undertaking of demonstration work in the paddy areas of the circle. G.E.B. 24 with its even ripening and fine quality had an easy spread. Another strain, A.E.B. 65, fared likewise in single-crop areas. Co. 2 (*Poombalai*) has done well in the southern portions of this circle where the season is definitely late. Adt. 5 is another strain that has made some headway. A.E.B. 65 and G.E.B. 24 are the strains which are generally in favour throughout the circle. The total area under the improved strains is over a lakh of acres and putting down the enhanced income from these introductions at Rs. 8 per acre, this single item of propaganda that has been carried on by the department mainly during the last decade may be evaluated at 8 lakhs of rupees. To meet the increasing demand and ensure the purity of seed about 850 acres are under seed farms, which in normal years would produce sufficient seed to sow 85,000 acres.

Other Crops.

256. Improved varieties of sugarcane, *ragi* and groundnut have just been introduced into the circle. In the case of *cumbu* the sowing of the crop with drills is an improvement whose value can be estimated at Rs. 4 per acre, resulting as it does in a saving in after-cultivation expenses. The value of this improvement is very great as *cumbu* is an important dry land cereal occupying an area of 3½ lakhs of acres in this circle.

Manures.

257. One of the biggest items of waste constantly occurring is the depletion of valuable manurial ingredients brought about by negligent storage of cattle manure. The ryot will not easily make up his mind to prevent this avoidable waste. Through intense propaganda a few ryots were induced to dig pits for the preservation of cattle manure. Many of them have begun to realize the utility of the simpler expedient of covering the manure heap with earth. The advantage of increasing the bulk of the manure available by the judicious incorporation of vegetable refuse is being recognized in an increasing measure.

Livestock.

258. To improve the livestock of the circle, 40 breeding bulls have been maintained in various parts of the district under the premium scheme. Of these 31 are *Kangayams* and 2 *Scindhes.* There are also 2 buffaloes. Good breeds of fowls have been intro- duced in large numbers and some apiaries have been started for demonstration purposes.

Legislative Measures.

259. The introduction of improved varieties of cotton is not by itself enough. Protection from pests is an important measure. The Pest Act was introduced in 1919 with decided advantage to the quality of the crop. *Pulichai* cotton which was practically elimi- nated from the circle made its appearance once again and the Cotton Control Act has been brought into force to keep out this inferior variety of cotton from tainting the superiority of the '*Tinnies*'.

Agricultural Education.

260. An Agricultural Middle School with an agricultural farm attached, for the benefit of *Kallars* was opened at Usilampatti (Madura district) in 1930 and is under the management of the District Board. The main object of this school is to give practical training to the students so that they may take up farming. Many *non-Kallar* students are also admitted and receive training. Two subordinate officers of the Agricultural Department, one as Head- master and another as Farm Superintendent were lent to the school.

Kovilpatti Research Station.

261. The Kovilpatti Agricultural Research Station was opened in the year 1901. The chief object of the station was to improve the local variety of cotton. When *karunganni*, the original '*Tinny*' cotton of this tract, got mixed up with *uppam* and other inferior varieties, the reputation for its quality was being gradually lost and it was found necessary to isolate *pure karunganni* cotton. This was achieved in the year 1913 when two new strains, Company No. 2 and Company No. 3, were made available for distribution.

The Company Cottons.

262. The Company Cottons on account of their good quality and better outturn began to spread rapidly and in the course of five years it was estimated that over 50 per cent of the area under cotton was grown with the departmental seed. At this stage the seed distribution was taken up by merchants, private individuals and seed unions. The purity of the seed was affected in consequence and the quality of the cotton deteriorated.

New Strains.

263. A scheme of systematic breeding was inaugurated in 1922 with the idea of isolating a number of strains suitable for the different conditions obtaining in this tract. In the year 1926, two strains A. 10 and C. 7 were evolved and made available for distribution. The former has been found suitable for tracts, north of Kovilpatti and the latter for those round about Kovilpatti and to the south of it. In spite of the excellent performance of these types in a normal season it was found that they suffered considerably, during periods of untimely rains when the crop was full of buds and bolls. The yield on such occasions was perceptibly reduced.

Kovilpatti No. 1.

264. Further attempts to find out a strain which would resist unseasonal rains and give a good crop even in a bad season have been successful and as a result of the examination of thousands of plants a new strain has been evolved and made available from the year 1933. This new strain, Kovilpatti No. 1, combines the good qualities of the older strains under distribution and in addition to these resists the bad effects of an unseasonal rain. There is a very great demand for this seed from the cultivators who have seen its performance. There is every reason to hope that the whole of the rainfed cotton area in this circle will shortly grow this variety.

Finer still.

265. This good work of isolation of better types of cotton is being pursued with a view to improve the quality still further and to increase the output of cotton. Two strains have already been obtained each of which is capable of spinning finer yarns and at the same time produce more lint for the same quantity of *kapas*. In other words, when Kovilpatti No. 1 can spin 24 warp yarns, the new strains are found suitable to spin at least 2 counts finer and they give a ginning percentage of 34 against the 32 per cent of Kovilpatti No. 1. These are distinct improvements and are of immense prospective value to the cultivators.

Rainfed Millets.

266. Besides the breeding of cotton, the improvement of the local millets, *cumbu* and *cholam* was taken up. Initial selections were made in 1930 and with the addition of a Millets Assistant to the staff the work progressed rapidly. During the last year several *cholam* and *cumbu* types were ready for comparative trials. One of the fodder *cholam* selections has given an increased yield of 30 per cent and a *cumbu* selection has given a 10 per cent increase over the unselected bulk. These trials will be repeated and steps taken to multiply the seeds rapidly for distribution.

Irrigated Millets.

267. Small areas of *cholam* and *cumbu* are grown in this tract in summer under well irrigation. The isolation of better varieties and the trial of the selections of the Millets Specialist at Coimbatore are being made to improve these food crops of the farmer. There are already four strains in the summer *cholam* which are yielding 12 to 37 per cent above the local variety and seeds of these are being multiplied for distribution. There are two *cumbu* selections which have given an increase of over 25 per cent in yield. The Coimbatore *ragi* strain, E.C. 593, was tested here and found to yield up to 60 per cent over the local in addition to being 10 days earlier. A regular seed supply of this improved strain is being maintained.

Manuring.

268. It is not sufficient to stop with the production of better yielding varieties. The land must be kept fertile to withstand the strain of increased production. With the idea of finding out the most suitable manure for this tract, elaborate experiments were laid out and very interesting observations were made. When one wants to increase his fodder output from a limited area he can safely apply up to 2 cwt. of ammonium sulphate per acre and obtain double his normal yield. He can do the same thing with *cumbu* but it is not so paying. This manure not only enhances the yield of the grain or fodder crop but a small residual effect is also left for the benefit of the following cotton.

Crop Rotation for Cotton.

269. It is a common knowledge in this tract that when cotton is raised after a crop of *cholam* the yield suffers to the extent of about 20 per cent in a normal season when compared to a crop after *cumbu*. In seasons of heavy rainfall the disparity is very much wider. On account of the poor quality of the *cumbu* straw the farmer is pressed to grow a fodder crop of *cholam* for his cattle. No other fodder compares favourably with the local *Irungu cholam* which is hardy and heavy yielding. Nevertheless, its bad effects, on the following cotton are patent. With a small staff financed by the Indian Central Cotton Committee, investigations are in progress to find out how the harmful effect is brought about and to suggest a remedy. Investigations show that the defect is not to be traceable to the deficiency of moisture nor to the stubbles left over by the crop and not even to the depletion of plant food. It has been discovered that there is some disturbance in the soil texture and that there is an increase in the content of sodium salts. It has been found that the application of ordinary manures to the *cholam* crop or ploughing up the soil after it, does not produce a favourable effect. Growing a leguminous fodder crop in the place of *cholam* is a remedy but this reduces the fodder output. Raising a *cholam* crop and cutting it off at the flowering time has a beneficial effect but again the tonnage of fodder suffers. By sowing

the fodder crop thick, a better yield of fodder is obtained, but the grain production is reduced. So far the effective remedy seems to be to grow the cotton crop thick or sow a crop like coriander or black gram mixed with cotton. These practices are easy to follow and reduce the harmful effects considerably and the cultivator can grow a fodder *cholam* crop immediately followed by cotton without any fear of a reduction in his cotton outturn. These details in the elaboration of the attack of what looks like a simple problem are given to convey an idea of the complexities involved in the solution of an agronomic problem.

Other Services.

270. Supply of pure seed, preservation of cattle manure, demonstration of improved methods of cultivation, use of improved water-lifts and labour-saving implements form the special features on the farm. Besides these, facilities are offered for those interested in the proper ginning and preservation of good seed to gin their cotton at the farm ginnery which is handy and under the strict control of the farm staff. Remedial measures against crop pests and diseases are being demonstrated at any time during the year by the Entomological and Mycological assistants stationed on the farm. The possibilities of growing new varieties of crops are vigilantly explored. As an example, grape-vines were planted five years ago when the crop was unknown round about this place. There are now many vines in the surrounding country. Stud bulls are kept for service for a small fee. Improved types of poultry are kept and the eggs and birds are sold in large numbers. Improved implements are issued for hire at nominal rates.

(*g*) The West Coast Circle.

The Seventh Circle.

271. The seventh (West Coast) circle consists of the districts of Malabar and South Kanara. The Deputy Director of the circle has his headquarters at Tellicherry. There were 4 demonstrators in 1922. With the present availability of 15 demonstrators, one for every taluk, the demonstration work is intensified. There are 12 demonstration *maistris*. Two assistants trained in Entomology and Mycology answer to calls for help in the control of pests and diseases. There is an Agricultural Research Station at Taliparamba. There is another at Pattambi, devoted to intense work on rice under the Paddy Specialist. The Coconut Research Stations at Kasargod, Nileshwar and Pilicode are under the Oil Seeds Specialist.

The total cultivated area of the circle is 2,512,000 acres. The acreages of the chief crops are—Paddy—1,461,000, oil seeds—390,000, arecanuts—104,000, pepper—95,700, pulses—72,700, plantains—57,200, mangoes—53,100, millets—38,100, and ginger—11,700.

Paddy.

272. Paddy is the predominant crop of this circle, more than half the cultivated area being under it. There is a steady demand for paddy seeds produced at the Research Stations on account of their superiority in yields, purity and good vitality. Large quantities of paddy seed of improved strains and bulk seed of local varieties are distributed every year and it is estimated that over 52,000 acres are now grown with crops raised from seed supplied by the department. The increased yield consequent on the distribution of these varieties ranged from 10 to 20 per cent. G.E.B. 24 and Co. 3 are the strains that have found favour with the ryots for the quality of the rice, better yield, increased husking percentage, uniform maturity, better tillering capacity and adaptability to excessive moisture conditions. G.E.B. 24 has made headway in the Palghat and Wynaad taluks and covers 25,000 acres in the former and 1,500 acres in the latter. Seed from four new strains evolved at the Pattambi Agricultural Research Station have been multiplied and made available for distribution recently. The saving of seed consequent on the reduction of seed rate by the use of these sound and pure seeds may be estimated to be about 25 per cent. Besides, by improving the cultural and manurial methods in vogue, the profit in paddy cultivation has been increased considerably owing to the intensive propaganda by the department. It is, therefore, no exaggeration to claim a clear financial gain of over 2 lakhs of rupees consequent on the introduction and spread of improved seed. This figure is arrived at, by estimating the improvement at the modest rate of Rs. 4 per acre over the 52,000 acres under the improvement. This represents a substantial advance over the 5,000 acres under which improved seed was used in 1922.

Coconut.

273. Nearly three-fourths of the area under coconuts in the presidency is in the West Coast. The study of coconuts was taken up in 1916 and the department has gained enough experience and done substantial work. In the case of this tree crop it takes time to progress. Carefully selected seed coconuts and seedlings for planting nearly 2,700 acres were supplied by the department during the last 12 years. The good results achieved on the coconut stations by systematic cultivation, proper spacing and judicious manuring were made known to the cultivators as effectively as possible. There were several demonstration plots throughout the circle. When the price of coconut fell, there was a set-back to the rapid extension of its cultivation. The improvement of coconut cultivation was taken up not only in the mainland, but also in the remote islands of the Laccadives, where coconut is the chief crop. A demonstrator is deputed every year to do propaganda work in these islands, and the islanders have realized and taken up improved

methods of planting, inter-cultivation and manuring with considerable advantage to themselves. One young man from the island of Androth received training at the Research Stations in the mainland.

Pepper.

274. Pepper is associated with the district of Malabar. It was a rare crop in the South Kanara district before its introduction was taken up by the department. It occupies over 7,500 acres in that district now. About 8½ lakhs of cuttings were supplied and got planted up during the last 12 years. There was a steady increase in the area under pepper especially in the Kasargod taluk when the price of pepper was high. The department was instrumental in encouraging the formation of two Co-operative Sale Societies for pepper-growers, one in Malabar and the other in South Kanara.

Arecanut.

275. Arecanut occupies over a lakh of acres in the West Coast. This important crop of the West Coast was subject to the attack of a fungus disease known as *Mahali*. Spraying of the bunches with Bordeaux Mixture (para. 127) was found to be the only remedy for this disease and a large number of arecanut trees were sprayed. Owners of large arecanut gardens in Malabar have now taken up this work as one of their regular agricultural operations. This disease having appeared in the South Kanara district, remedial measures are being taken promptly to control the same and to educate the people in preventive measures. About 4 lakhs of trees were sprayed during the year 1935 and a bigger campaign is being organized for the coming season. The value of these preventive measures can be put down at the rate of as. 2 per tree. *Takkavi* loans are being granted for purchasing sprayers. Depots for the sale of sprayers and chemicals are to be opened in important centres.

Sugarcane.

276. There are nearly 4,000 acres under sugarcane in the circle. The department is solely responsible for the successful introduction of such improved varieties of canes as Red Mauritius, Barbados and Fiji B. The practice of growing *kolingi* for manuring the crop is being demonstrated with success. The use of concentrated manures has been advocated and manure firms have opened business centres in the South Kanara district. Iron mills driven by cattle and oil engines are in general use. Almost all sugarcane-growing villages have improved furnaces which when not in use for boiling sugarcane juice, are used for boiling paddy. There is, in this dual use, considerable economy in the fuel bill of the cultivator. The introduction of improved canes, their manuring with concentrates, crushing with improved mills and the boiling of jaggery

over improved furnaces, are a chain of co-ordinated improvements which, in a paddy tract, has meant a gain of several lakhs of rupees to the cultivators of the circle.

Ginger.

277. Ginger with its 11,700 acres, is another of the cash crops of the circle. New varieties from Bengal, Jamaica, and Trinidad are being tried at the Research Stations with a view to their distribution in the ginger-growing tracts of the circle.

Plantain.

278. The famous *Nendrum* plantains of Malabar were not cultivated in the Northern portion of the South Kanara district, but the demand for fruit was being met by importations from Malabar. The department has spread this variety in this portion of the district and the new introduction is steadily finding favour with the ryots. Eight thousand and seven hundred suckers were distributed in 1934.

Pine-apple.

279. The cultivation of pine-apple has increased phenomenally during the last decade. Its luscious fruits are very much in demand and find a ready sale in urban areas. The climatic and soil conditions of the circle favour its growth. To the rich it is a wholesome fruit for consumption and to the poor it fetches ready cash. The department is responsible for the introduction of good varieties like Kew and Mauritius which could be grown as rainfed crops in dry lands. Over 1,000 acres are under pine-apple cultivation in the circle. This area tends to increase. Suckers are in great demand in and outside the circle. The Agricultural Stations are endeavouring to meet this demand; nearly 50,000 suckers were supplied from the circle in 1934. A gain of about a lakh of rupees can be claimed in favour of the introduction and spread of improved varieties of this fruit.

Tapioca.

280. Tapioca is well known in Malabar and provides wholesome food to the poor. It is easily cultivated and thrives in poor lands. Better varieties like the Butter-stick have been introduced and have spread rapidly. This crop was not common in South Kanara but has been introduced there and is spreading. In 1934 nearly a lakh of cuttings were supplied for planting up in the extended areas.

Fruit Trees.

281. Formerly jack-fruits and inferior mangoes were the only fruits available on the West Coast. Most of the old trees giving these fruits are being cut for timber. Of late the cultivation of graft mangoes, sapotas, papayas, guavas, pomegranates, limes and

oranges is receiving a great impetus and every year large numbers of these are being planted up, and taken good care of through the strenuous efforts of the demonstrators. Selected grafts of fruit plants especially of mango and sapota are supplied from reliable nursery-men and proper advice is given on their planting and manuring. The fall in the price of coconuts and an appreciation of the dietetic value of fruits have contributed much towards the increase in the area under fruit trees.

Cashewnut.

282. In recent years the price of cashewnut has been going up on account of the increased export of the kernels to European countries. The bright prospects awaiting cashewnut cultivation are being constantly brought to the notice of the ryots and they are helped to extend its cultivation in the circle. Good seed is supplied and advice on proper spacing and care of the plantation is also being given. As a result of propaganda, the area under cashewnut is going up and unoccupied waste land is being planted up in increasing areas.

Manures.

283. To make up the slow and normal decline in the productivity of the paddy-growing areas of the littoral tract, where green leaves are not easily available, the growing of a green manure crop was advocated. After many years of persistent advocacy and demonstration, *kolingi* has now fairly established itself in the coastal villages of both the districts. Over 1,000 acres are being sown with this green manure crop. The ryots are taking to the practice of growing this valuable crop as is evidenced by their increasing inclination to gather their own seed.

In the Malabar district a great deal of propaganda has resulted in an appreciation of the need for the better preservation of cattle manure, a manure of immense value to the ryots. By constant persuation nearly 2,400 pits have been dug up and roofed for the storage of this valuable manure. In conjunction with this the utilization of organic waste material for manurial purposes is also being demonstrated.

The use of fish guano as manure has been well established and the demand for it is steady. When the catch of sardine was good a demand from outside the circle put up prices with the result that local use was restricted. This uncertainty coupled with the poor catch of fish in recent years makes any calculation of its use uncertain. But the fact remains that the utility of this valuable manure is well recognized both in and outside the circle.

Oil cakes were not formerly made much use of for manuring crops. Now such oil cakes as *neem*, groundnut, castor and *pungam* are being largely used for manurial purposes. About 84 tons were sold during the last 12 years.

The use of bonemeal, nitrate of soda, ammonium sulphate and compound manures such as ammophos and niciphos is being demonstrated. These manures are getting popular and private depots supplying concentrated manures in small quantities and at cheap rates have been opened in all important towns.

Implements.

284. Demonstrations of the working of small iron ploughs such as Meston, Konkan and Cooper No. 25 are being done. As a result of these demonstrations nearly 1,600 ploughs are now in use.

Livestock.

285. Efforts are being made to improve the cattle of the circle by maintaining breeding bulls and granting premia to private people and organizations owning breeding bulls. Mostly *Scindhe* bulls are kept with the object of improving the milk yield of the West Coast cattle. At present three bulls are maintained by the department attached to the Veterinary hospitals at Mangalore and Cannanore and one breeding buffalo is stationed at the Research Station, Taliparamba. In addition to these, 11 bulls owned by Local Boards, Co-operative Societies, Agricultural Associations and private individuals receive the annual Government grant of Rs. 100 for efficient maintenance and service. On an average about 50 calves are born to each of these bulls annually. To encourage the feeding of young stock, prizes are also given. Cattle owners are being advised to raise fodder crops such as guinea grass, elephant grass, *cholam* and *cumbu* and the practice is slowly gaining ground. Demonstration and propaganda are also done in the preparation of silage and hay from hill grass to provide fodder during the months of scarcity.

Poultry.

286. An awakening has been created among the ryots to keep improved breeds of poultry such as Rhode Island Red and White Leg-horn and every year a large number of eggs are supplied to them for hatching purpose from the Hosur Livestock Station. Birds of these improved breeds are now found in almost all the towns on the West Coast. A few well-to-do ryots in rural areas also maintain these breeds.

Bee-keeping.

287. In recent years, a keen interest has been created among the educated people in bee-keeping. Assistance is being rendered in supplying bee-hives, locating wild colonies and hiving them, extracting honey with separators and in the proper method of maintaining the colonies. There are at present about 110 colonies maintained by private people in different parts of the circle. There are great possibilities of developing this line of work in a circle so rich in vegetation and so full of flowers.

Insect Pests.

288. Reports of depredations by various insect pests received from time to time are being handled by the demonstrators in their regular propaganda tours. Whenever occasions arose, campaigns were started to combat the *Nephantis* havoc on coconut, and the Spodoptera, Grasshopper and Rice-hispa pests of paddy. The insect *Nephantis serinopa* appeared for the first time in pest form in August 1922 and began to scourge the coconut gardens mercilessly. The Pest Act was passed and administered till 1931, very smoothly, and free from any kind of resistance. Operation of the affected trees was done very briskly till 1927 and over two lakhs of trees were operated and saved. In 1928, the method of controlling this pest by breeding its enemy was begun and the parasite breeding work was started at Ponnani, Calicut and Mangalore and the pest was controlled to a great extent by the liberation of the parasites till 1930. The pest has now almost subsided. The campaign against the swarming caterpillar (*Spodoptera*) was started in 1924 and continued in selected taluks till 1931. During this period officers went round the villages and educated the public about the life history of the pest and control methods. The campaign against grasshopper was started only in the Palghat taluk where the pest is of regular occurrence. There are signs of real interest in the control measures to be adopted against pests in general by the ryot population.

Fungus Diseases.

289. The damp climate of the circle during a greater part of the year is congenial to the outbreak of fungus diseases and their spread. The control of such diseases received attention. The *Mahali* disease of arecanut used to cause considerable damage in Malabar but now the ryots adopt the control measure suggested by the department whenever the disease appears and in South Kanara special preventive spraying is being done now against the spread of the disease. About 18 lakhs of arecanut trees were sprayed for the control of *Mahali* during the last 12 years. The Bud-rot of palmyra is another important fungus disease which appeared recently in the Palghat taluk. Thirty thousand palmyra trees were operated for Bud-rot. Several coconut trees were treated for the stem-bleeding disease and many fruit trees for the die-back disease which results in the drying up of the twigs.

Exhibitions and Lectures.

290. Several exhibitions were conducted and lectures delivered for educating the public on the activities of the department. Two big exhibitions are held annually one in each district and 15 small exhibitions, one in each taluk during important festival occasions. In addition to these whenever requests are received from local bodies, co-operative organizations, educational and revenue authorities and the health department, small exhibitions are arranged.

Large numbers of leaflets on agricultural subjects are freely distributed to the public at the time of these exhibitions. Since 1929 considerable impetus has been given to the propaganda work by the Motor Exhibition Vans which tour in the circle for three to four months in the year.

Co-operation with other Departments and Organizations.

291. Whenever opportunities arose assistance was rendered to other departments and organizations. Just after the *Mopla* rebellion, officers of this circle rendered considerable help in the reconstruction work in procuring paddy seeds and distributing them in the affected areas.

Under the Court of Wards three home farms were started and departmental assistance was rendered in running these farms for seven years till they were handed over to the Zamorin in 1927. The coconut gardens owned by the Forest department at Beypore, the Mopla Orphanage at Chevayur, the Devadhar Malabar Reconstruction Trust Farms at Tanur and Quilandy and the Nayadi Colony at Olavakode, received constant attention from the officers of this department.

The gardens belonging to the Central Jail, Cannanore, and the Mental Hospital at Calicut, were visited by demonstrators and advice given in the matter of their proper upkeep.

The District Board, South Kanara, started fourteen coconut demonstration plots in the district some ten years back and these plots are being maintained at the cost of the Board and under the supervision of the department.

Takkavi Loans.

292. On account of the financial depression, ryots find it difficult to pay ready cash for purchasing agricultural implements and machinery. To tide over this difficulty gazetted officers of this department were permitted since 1933 to grant small loans to ryots for the purchase of ploughs, *mhote* wheels, sprayers and other such useful implements. In the course of three years, 50 loans amounting to Rs. 750 were granted to enable ryots to purchase 44 ploughs, 17 *mhote* wheels and 17 sprayers.

Taliparamba Research Station.

293. Although the station was originally started in 1905 for the study of the pepper vine and its cultivation, in recent years the study of various other crops such as paddy, sugarcane, coconut, arecanut, plantain, ginger, chilli, and pine-apple is receiving attention. The main problems that are under investigation are, the manurial requirements of the pepper vine and the trial of different varieties of crops and fruit trees to find out their suitability to the tract. There is a large demand for grafts of superior varieties of mango and arrangements are being made to meet this demand from

this station. The local variety of ginger has become degenerated, and superior varieties from Bengal, Jamaica and Trinidad are under trial with a view to replace them. The study of cashewnut, which has become an economic crop in the West Coast on account of the large export of kernels to European countries is in progress. The demand for various kinds of seeds, cuttings and suckers produced at the station is increasing year after year and the station is endeavouring to meet this demand. Dairy farming and such side lines of agriculture as poultry farming and bee-keeping receive attention at the station.

The Agricultural Middle School, Taliparamba.

294. From 1922 to 1932, for a period of ten years, an Agricultural Middle School was attached to the Research Station where agricultural education of a practical nature was imparted to the sons of cultivators. The number of admissions decreased in later years and the school had to be closed as a measure of retrenchment. Many of the students who received education in the school have gone back to the land and taken up farming. Government have again sanctioned the starting of a school course in Farm Management from May 1936 and arrangements are being made to make use of the buildings erected for the Agricultural Middle School.

(h) The Coimbatore Circle.

The Eighth Circle.

295. The eighth (Coimbatore) circle comprises the districts of Coimbatore, Salem and the Nilgiris. The Deputy Director of Agriculture is at Coimbatore with two Assistant Directors of Agriculture, one at Coimbatore and the other at Salem. The Agricultural Research Station at Nanjanad in the Nilgiris has a gazetted Superintendent in charge of it. There are 23 demonstrators in the circle and 14 demonstration *maistris*. At Tiruppur there is a Business Manager in charge of the Co. 2 cotton seed multiplication scheme financed by the Indian Central Cotton Committee. Six demonstrators and six *maistris* work in the scheme.

The total cultivated area of this circle is 4,145,000 acres. The acreages of the important crops are, millets—2,217,000, pulses—589,000, oil seeds—433,000, cotton—401,000, paddy—227,000, tobacco—34,800, chillies—20,700, potatoes—13,200, and sugarcane—11,700.

Paddy.

296. Of the 227,000 acres of paddy grown in the circle, 28,800 acres are under new varieties such as G.E.B. 24, Co. 1 to 8, Adt. 5 and Adt. 11. The yield of these strains is generally about 10–15 per cent above the local varieties which they replace. Taking the value of the increase as being Rs. 5 per acre the total gain

will amount to Rs. 1,44,000. The seed-rate has been reduced and economic planting practised on 40,000 acres which at a gain of Rs. 2–8–0 per acre amounts to Rs. 1,00,000.

Millets.

297. E.C. 593 and H. 22 varieties of *ragi* are now estimated to cover 6,000 acres. Different varieties of *cholam*, *cumbu*, and *tenai* are under test. Intended for a tract of low and precarious rainfall, the performance of millet strains have to be judged by averaging their yields through years and from various places. *Peria manjal cholam* strain A.S. 29, *chitrai cholam* strain A.S. 1575, and *chinna manjal cholam* strain A.S. 809 have done well in varying degrees. The increase in yield varies from 10 to 50 per cent and naturally fluctuates with season and place. Surangi *cumbu*—P.T. 17—has given increased yields of both grain and straw. In *tenai*, the frail dry land cereal, strain No. S.I. 523, is doing well in the Salem district.

Sugarcane.

298. Local canes such as *poovan*, *vellai* and *nanal* have deteriorated due to the diseases red-rot and mosaic. New varieties such as Co. 213 and Co. 290 intended for poor land with poor water facilities will grow where *poovan* and *vellai* will not be successful and under good conditions can produce up to double the yield of local cane. Other new canes are under trial as also sorghum crosses and canes introduced from other countries, e.g., Fiji B and P.O.J. 2878.

The area under improved canes is 1,700 acres out of a total of 11,740 in the circle. If Rs. 30 per acre is taken as the value of the increased income per acre, this amounts to an additional gain of Rs. 51,000. Demonstration on the selection of seed material free from the disease of red-rot, etc., has been carried out and the efficacy of this work proved on over 500 acres. The necessity for efficient mills for crushing cane is known to the ryots and advice is given on proper types of mills. Improved methods in the preparation of jaggery, e.g., the use of activated carbon, and *Bendakai* (ladies finger), have also been demonstrated. There are 500 improved furnaces of the *Sindwahi* type now in existence, which at a saving of Rs. 20 in fuel per furnace brings in a total saving of Rs. 10,000.

Groundnut.

299. The Gudiyattam Bunch variety, owing to ease of harvesting is spreading rapidly as against the local variety. Two new strains of groundnut have been introduced recently—A.H. 25 and A.H. 32.

Cotton.

300. Cotton is the most important fibre crop of the circle and much work has been done on it. Cambodia strain No. 2 was introduced in 1927 and gives an increased yield of about half a *pothy*

(*potty*—250 lb.) per acre more than previous strains. The department runs about 800—1,000 acres of seed farms on ryots' land, gathers the *kapas* and gins it, sells the lint on the ryots' behalf and carefully stores the seed for next year's sowings. This seed supply was inadequate and three years ago, the Tiruppur Co-operative Trading Society, with financial aid from the Indian Central Cotton Committee and the trained staff from the Agricultural department, started with 2,000 acres of seed farms and this year have 6,000 acres of seed farms worked on the same lines as the Agricultural department seed farms. The total area under Co. 2 strain is estimated at 83,000 acres, but with the large amount of seed now being produced, the natural spread of this strain must be larger and will at least amount to 100,000 acres, which at Rs. 15 per acre amounts to a gain of 15 lakhs of rupees to the Cambodia growers. New strains, which promise better than Co. 2 are now being tried out in consultation with the Cotton Specialist. Line sowing of Cambodia cotton is spreading but it is found easier to dibble the seed by hand than to use the *gorru*. One thousand and five hundred acres were line-sown in 1935.

Seed farms for the *karunganni* variety to the extent of about 800 acres are being carried on in the Udamalpet taluk. The area under the departmental strain is estimated to be 16,800 acres which at a gain of Rs. 5 per acre amounts to a total gain of Rs. 84,000.

Fodder Crops.

301. *Peria manjal cholam* is being largely distributed in Salem as a fodder crop. The growing of lucerne, guinea grass, etc., is being advocated for milch cows and the preparation of silage has been demonstrated in many cases.

Fruit.

302. The main fruit districts are the Nilgiris and Salem in which the Shevaroys produce large quantities of oranges. Grapevine cultivation is carried on in the Krishnagiri taluk, but owing to poor methods of irrigation and manuring, the area is decreasing. Work in this direction has shown that large increase in yield can be obtained by proper irrigation and manuring and the protection of leaf and fruit from mildew attack by spraying. Advice along these directions is being given. Many different varieties of fruit trees have been distributed in the circle.

Plantation Crops.

303. There are 35,400 acres under coffee and 60,000 acres under tea in this circle, mostly the Anamalais, Shevaroys and Nilgiris. The Scientific Officers of the United Planters' Association advise their members on these crops. For smaller growers the department gives advice on manuring and pruning. This work is mostly done in the Nilgiris.

Implements.

304. The primary essentials of cultivation are (1) necessary depth of working, (2) thorough mixing up of the soil as is done with the crow-bar and *mamooty*, and (3) control of weeds. These results are more easily achieved by the use of a mould-board plough and the ryots are generally beginning to realize the advantage of using the light iron ploughs now being manufactured satisfactorily in India itself. The common wooden plough does not invert the soil and is not very efficient. The sales of iron ploughs for the ten years ending with 1933 show a total of 1,878 with a progressive increase from 84 in 1924 to 604 in 1934. Taking each plough as ploughing 10 acres annually, the total acreage now being ploughed with these improved ploughs is 18,780 acres. Increased efficiency and better yield due to inversion ploughings may be estimated at Rs. 2 per acre and the total gain therefrom is Rs. 37,560.

While the plough is the commonest implement in use, many of the secondary cultivation operations can be more economically carried out by other implements like the *guntaka*. One hundred and four H.M. *guntakas* were sold in the last three years since they were designed and introduced. At 20 acres per implement, this will amount to 2,080 acres at an efficiency value of Re. 1 per acre.

A new implement called the bund-former was designed by the Research Engineer and was introduced two years ago, since when 38 of them have been sold. This implement is estimated to save Re. 1 per acre in making up the small bunds necessary for bed irrigation. The bund-former can also be used in making ridges and furrows.

Owing to the uneven depth at which the seed falls when seed is broadcasted and then ploughed in, more seed has to be sown than where the seed is planted at the proper depth for germination. The Ceded District *gorru* has been tried out for many years in the Coimbatore district, but the ryots have not taken to it partly due to the fact that experience is necessary in setting the implement at the proper depth and also in the amount of seed to be sown and distributed evenly to the various tynes. Mechanical seed drills produced by the Research Engineer have been tried out on various crops and 186 acres were sown in 1935. There is great scope for a cheap machine of this type especially when inter-cultivating implements like the No. 1 and No. 0 *guntakas* are used with them.

The area worked by these implements is now increasing year by year and special *takkavi* loans are being given to hasten the progress of distribution.

Farm Yard Manure.

305. The commonest manure in use is farm yard manure. The amount of manure available roughly has been calculated at less than half a ton per acre cropped, taking into consideration the number of livestock available. Very little manure is used on dry lands and

the bulk of the manure produced is used on garden lands. Even then the manure used will amount to only 2—2½ tons per acre on the average. Naturally such a position demanded attention and much propaganda has been carried out on the preservation and increase in the amount of farm yard manure produced. Generally in the Coimbatore and Salem districts the ryots are careful in the collection of their manure; and increases in the amount prepared can be obtained by using all farm waste and sweepings, crop residues and green material available and adding them to the farm yard manure together with the urine which is often allowed to go to waste. Many ryots have doubled their output of farm yard manure by these means. It is estimated that there are 14,000 manure pits now in existence yielding approximately 560,000 cart-loads of farm yard manure. The extra manurial value may be taken as annas four per cart-load or a total money value of Rs. 1,40,000. There is room for much further improvement in this direction.

Green Manure.

306. For paddy, green leaf and green manures are largely used. The restriction of leaf obtained from forest areas had led to the development of green manuring. *Dhaincha*, sunnhemp and *kolingi*, are most useful in this connexion and the Salem ryots have now developed seed producing areas in Attur and Rasipuram for *dhaincha* and sunnhemp. *Kolingi* is largely grown and is self-seeding. The area annually put down to green manure is estimated at 18,500 acres and the saving to the ryot taken at Rs. 5 per acre amounts to Rs. 92,500 per annum.

Artificial Manure.

307. Certain cash crops like sugarcane, tobacco and potatoes respond to the judicious use of concentrated manures like oil-cakes, bonemeal, sulphate of ammonia, super-phosphate and potash in conjunction with farm yard manure, green manure and composts. There is no doubt but that there is a great future for concentrated manures in the production of cash crops especially and many experiments have been carried out by the department to find out the economic doses which may be applied. Advice on this subject can therefore be given to the ryots, but the distribution of the manure is left to the firms in this concentrated manures trade. As such it is difficult to get exact figures of consumption of manure, but it is estimated that about 16,500 acres get concentrated manure annually.

Pests and Diseases.

308. All crops are subjected more or less to the ravages of pests and diseases. Even the most conservative ryots begin to acknowledge the usefulness of the department when suitable advice and demonstrations are given to show them how to save their crop.

Where mass action is indicated, legislation has already been passed, e.g., the Pest Acts on Cotton and Groundnut. In the first case, legislation aims at having the old cotton plants pulled out so that the pests cannot attack the newly sown crops. The Pest Act on Groundnut aims at destroying the hairy caterpillar. In addition to such measures, ryots are now purchasing spraying machines for use against tobacco aphis, mildew on grapes, etc.'

Livestock.

309. Cattle are essential to Indian agriculture for work, milk and manure and it is necessary that they should be efficient. In the old days of graziers, good stud bulls were maintained and as these died out and the land was subdivided for cultivation, the temple bulls served the function of stud bulls. Now temple bulls have largely disappeared and it is impossible for small ryots with a few cows each to maintain good bulls. It is therefore, essential that there should be some form of organization and co-operation whereby good stud bulls are available in sufficient numbers to these small ryots.

In order to stimulate interest in this work, Government granted premiums of Rs. 100 per annum to approved bulls, which did 50 services or over. The District Boards of Coimbatore and Salem have also agreed on the necessity for work in this direction. The District Board, Coimbatore, now purchases a number of bulls annually and places them out with approved men on the understanding that if 50 services are performed per annum for two years the bulls become the property of the approved men.

The premium scheme started in 1928 with 3 bulls and there are now 34 bulls in the circle. During the last five years, 7,546 services were performed. If it is taken that 7,000 calves resulted and the increased value of each calf was Rs. 10, Rs. 70,000 has been added to the cattle wealth of the country. The number of breeding cows and buffaloes in the circle is over 10 lakhs and at one bull per 100, over 10,000 stud bulls are required.

Dairying.

310. The dairy industry is increasing near the large towns especially in Coimbatore where the industrial population is increasing with the erection of more cotton mills. Five *Scindhe* bulls are now stationed in and around Coimbatore—2 with the Superintendent, Central Jail, 2 with the Coimbatore Municipality, and 1 at Idigarai, a village 10 miles from Coimbatore.

Poultry, Pigs and Bees.

311. Many small flocks of imported birds chiefly White Leghorns, Rhode Island Reds, Black Minorcas are kept throughout the circle and several large ones in the Nilgiris. The chief difficulty met with is disease and many promising flocks are wiped out. Cleanliness and proper rations are essential and are recommended.

Berkshire pigs supplied by the department are being bred on a fairly large scale by ryots round Periyanayakkanpalaiyam near Coimbatore and there are now 200 pigs maintained. Difficulty was met in marketing the pigs to advantage until one of the ryots concerned took up the problem and is now marketing the pork in the Nilgiris, where the demand is greatest.

About 110 bee-hives are now maintained in the circle.

Co-operation.

312. The department in collaboration with the Co-operative department has started seven Agricultural Improvement Societies. Some of these are carrying out useful work, e.g., the one in Pudupatti in the Salem district. Sales and purchases for members are conducted through the Society. The work of the agricultural demonstrator in spreading the improvements suggested is lightened considerably by the personal interest of the members and discussion of results achieved. The Tiruppur Co-operative Trading Society, with the aid of the department and of the Indian Central Cotton Committee is engaged in producing high quality seed of Co. 2 Cambodia for sale among other co-operative societies and to individual ryots. Ryots are also helped with loans for cultivation expenses.

Exhibitions.

313. Twenty-five exhibitions are conducted annually in important centres during festivals where ryots congregate in large numbers. Lantern lectures are given. Exhibition vans tour throughout the districts for about four months annually, displaying exhibits illustrative of many lines of interest to the ryots.

Irrigation Experiments.

314. Government are now investigating the Lower Bhavani Project to be executed as an irrigated-dry land scheme and for the purpose of conducting experiments two blocks of about 100 acres each, have been chosen near Gobichettipalaiyam and Kodumudi. The ryots have levelled their own land and water is supplied under the observation of the officers of the Agricultural and Public Works Departments. The results obtained from these large scale experiments, will form a sound basis for the Lower Bhavani Scheme. This project, unlike most other irrigation projects in the Presidency aims at supplying water for raising garden land crops instead of wet crops and as the amount of water required for garden land crops is less than for such crops as paddy, a larger area can be supplied with water, thereby benefiting a large number of ryots.

Nanjanad Research Station and Potatoes.

315. The Agricultural Research Station, Nanjanad, was established in 1917. It is in the Nilgiris district, 10 miles from the Ootacamund railway station. The chief crop is potato. The objects

of the station are (1) to import and grow disease-free potatoes of good varieties for seed production and distribution, (2) to experiment with the different kinds of manures and find out the most suitable for the district, (3) to carry out experiments with green manures and rotation of crops, and (4) to encourage the ryots to adopt more up-to-date and profitable methods and grow better varieties of potatoes. Under a grant from the Imperial Council of Agricultural Research, a Superintendent was appointed to the Station for a period of five years, for more intensive research work on potatoes and breeding of new varieties for seed. Potatoes are grown on about 11,500 acres in the Nilgiris. It has been found that the varieties Great Scot, Royal Kidney, and Ben Cruachan are suitable and the first is greatly liked by the ryots and the trade. These selected varieties now occupy about 9,000 acres, which at an extra profit of Rs. 20 per acre amounts to a gain of Rs. 18,000 for this crop.

Much work has also been done on a suitable manure mixture and the following is now being used on the Nanjanad Station. Five hundred pounds of groundnut cake, 200 lb. of sulphate of ammonia, 350 lb. steamed bone-meal, 336 lb. concentrated super, and 224 lb. sulphate of potash per acre in addition to 5 tons farm-yard manure per acre. By the use of large quantities of litter 6 tons farm-yard manure are being produced per animal annually at a cost of about Rs. 2–8–0 per ton.

Crops grown in rotation with potatoes, like wheat, oats, barley, *samai* and *korali* are being tried out and green manures such as lupins are used. Soil acidity has been reduced by liming and lucerne and clover can now be grown fairly well.

CHAPTER V.

AGRICULTURAL MARKETING.

Agricultural Marketing.

316. It is not enough to improve the quality or increase the quantity of the cultivators' outturn. The best inducement to make him take to improved seed or to improved methods of cultivation is to ensure that he will get the best possible financial return for his special endeavour. This brings into prominence the all important question of agricultural marketing. The Royal Commission on Agriculture, the Banking Enquiry Committee and the Provincial Economic Conference, all of them urged an intensive programme to develop marketing facilities on the following lines : Organization of facilities including the opening of regular markets, the improvement of ware-housing facilities, the further development of co-operative marketing, the appointment of Provincial Marketing Officers and the establishment of Provincial Marketing Boards.

Marketing Officers.

317. In response to the above recommendations, a Provincial Marketing Officer was appointed in July 1934. With the help of funds provided by the Imperial Council of Agricultural Research three Assistant Marketing Officers were appointed in February 1935. The necessary staff has thus been provided to concentrate on the marketing survey which will provide a sound basis for developmental work like the formation of marketing organizations, etc. These surveys cover a wide range of agricultural products like rice, groundnut, linseed, wheat, tobacco, fruits, eggs, milk, milk products, livestock, hides and skins. Attempts were made for the publication at different centres of prices current in the producing and consuming centres of paddy. This publication of prices will tend to promote a healthy spirit of controlled market competition amongst the traders. Some agricultural associations have commenced to publish market reports. Steps are being taken for the publication in Madras of a weekly market report of the wholesale prices of some of the chief commodities at the important market centres. A record of prices of agricultural commodities has begun to be maintained. A beginning has been made in the starting of rice, groundnut, and sugarcane-jaggery sale societies. It is very desirable to adopt one standard unit of weight and volume throughout the presidency to eliminate fraud and the importance of this to marketing is being urged on Government. With reference to potato trade, steps are being taken to safeguard the Nilgiri potato. The trade in this is declining due to increased production in other provinces and increased imports from foreign countries. It is

desirable to shift the centre of trade from Mettupalayam at the foot of the hills to Coonoor and Ootacamund on the hill itself. Marketing surveys reveal the need for a rapid increase of the area under coriander and garlic for which there is a great demand from our neighbour, Ceylon. The heavy imports of arecanuts necessitate vigilance on the part of the arecanut growers of Malabar. To facilitate the transport of plantains to North India steps were taken to reduce the railway freight on wholesale consignments by about 20 per cent. Information regarding the acreages of different crops and monthly and annual export and import trade for important crops, was obtained. An atlas was prepared showing the distribution of the crops tobacco, groundnut and linseed and of livestock. A close touch was maintained with the Agricultural Marketing Adviser to the Imperial Council. An Agricultural Statistics Committee to advise on questions relating to the collection and interpretation of agricultural statistics was constituted. A scheme of sampling of villages for estimating the normal yield of crops by crop cutting experiments was drawn up. These are some of the many activities inaugurated by this new expansion into the all-important domain of marketing, and the present and prospective effect of this development are apparent.

The Provincial Marketing Board.

318. A Provincial Marketing Board was constituted in August 1934. The Board has started functioning and among its activities are a recommendation for the prohibition of the imports of foreign rice or the levy of a heavy duty thereon, the imposition of quota on the imports of rice from Burma, the reduction of railway freights to a reasonable proportion of the value of produce transported, the investigation of the possibilities of opening more ports for the export of rice, the examination of the possibilities of the grant of loans to individuals on the security of standing commercial crops, the possibility of utilizing the surpluses of Central Co-operative Banks for the construction of godowns, the necessity for the standardization of weights and measures for important commercial crops, and the consideration of the rules to regulate the price of sugarcane for use in sugar factories. The handling of this wide range of agro-economic problems so very essential for the material prosperity of the cultivator by an expert body is a happy augury.

Economic Enquiry into the cost of production of crops.

319. The cost of production of crops is an important item in the evaluation of the general economic condition of the cultivator and in the marketing of his produce. In most cases, being an industry run by himself and the members of his family, there are no regular accounts kept from which useful conclusions could be drawn. This defect in our knowledge was not noticed until it was necessary to go into the question for the sugarcane industry and the aid which

the State planned to give it. The Sugar Committee of the Imperial Council of Agricultural Research went into the question of the cost of production of sugarcane and came to the conclusion that the results of such an enquiry would be of great value in deciding upon the sugarcane areas that had the best prospects for development and the places and the manner in which funds for research and experimental work could best be allotted. The Indian Central Cotton Committee also desired that an enquiry of this kind should include cotton and the crops grown in rotation with it. The Imperial Council of Agricultural Research, therefore, sanctioned a scheme of economic enquiry for three years in eleven provinces including Madras. The object of the scheme is to make an economic enquiry into the actual cost of production of the chief crops, to find out which crops would yield some reasonable source of living to the farmer and how the cost of production compared with that of other countries. The headquarters Deputy Director of Agriculture, Madras, is in charge of the enquiry in this presidency assisted by an adequate staff. The enquiry is instituted in the districts of Vizagapatam, Bellary and Coimbatore. Six typical villages in each of these districts have been chosen and eight holdings in each village are taken up for investigation. There is an investigator in each village who records all the agricultural operations in the holdings including their cost. The data from all these sources are compiled and a report embodying the results of the enquiry will be ready at the end of the year. This report will throw light on one of the least known aspects of the economic condition of the cultivator.

Rice and Coconuts—Production and Trade.

320. The price of rice, the most important food-crop of the province, has been steadily going down during the last two or three years making the position of the rice-growers of the province more and more difficult. A special officer was appointed to make a study of the rice production and trade, its stocks, movements and prices. After an extensive enquiry lasting for six months he has submitted a report with his recommendations and the Government are taking action thereon.

A special enquiry into the rice trade of Tanjore with Ceylon revealed the more advantageous freight position of Burma. The South Indian Railway has, on representation, made a reduction in its freight on rice to Ceylon, thus creating a more favourable position for Tanjore.

In furtherance of the Indian oil crusher industry the Imperial Council of Agricultural Research instituted in 1933 a special enquiry into the causes of the unduly low prices of coconut products in South India. A special officer from Madras conducted the enquiry and much valuable information has been gathered and is being utilized to alleviate the situation arising out of the depression in the *copra* trade.

CHAPTER VI.

LEGISLATION.

Collective Security.

321. Agriculture requires corporate activity on the part of the cultivators. When pests and diseases break out, conjoint action alone can cope with them. The antipathy or apathy of one individual will nullify the endeavours of the rest of the community. Similar is the case with trade in agricultural products. The fraudulent practices of an individual may tarnish the fair name of a reputed commodity. To ensure corporate action and penalize offenders legislative action even in the field of such a peaceful occupation as agriculture is necessary. Such legislation, inasmuch as it curbs selfishness proves irksome to a large number of people. Under these circumstances the Legislative record of the post-reform period in the interest of the general farmer has been very noteworthy. It is gratifying to note the general smoothness with which these curtailments in individual liberty have operated to the general good of the agricultural community at large and the trading interests in particular. The need for such measures and the manner in which they have operated are briefly narrated below.

Pest Act for Cambodia Cotton.

322. In the years 1918 and 1919 it was noticed that a great deterioration was taking place in the quality of Cambodia cotton, resulting in an increase of stained cotton containing weak fibre. This was traced to the fact that practically every field was badly infected with two insect pests. The first of these, the stem weevil (*Pempheris affinis*) damages the stem and weakens or kills the whole plant; the second, the pink boll-worm (*Platyedra gossypiella*) bores its way into the cotton boll and feeds on the seeds, damaging and staining the cotton lint in the process. Both insects develop winged forms which can fly from field to field, laying their eggs on fresh cotton plants. Tempted by the high prices of cotton many ryots had left their Cambodia crop on the field for two or three years instead of pulling it up at the end of the season and rotating with another crop. The result was disastrous. The insect pests could multiply unchecked all the year round, and did so. The 1919 crop in particular was so damaged, that the price fell by Rs. 25 a bale as soon as the new crop came into the market. Luckily, the Agricultural Pests and Diseases Act, III of 1919, had by then been passed and it was promptly put into force in that year in the Coimbatore district. Under this Act, ryots were required to remove

all Cambodia cotton plants from their fields before 1st August. The Pest Act applicable to Cambodia cotton has been in force for a number of years now and considerable experience has been gained in its enforcement. There is naturally a tendency in odd areas to evade its rigour. Delayed sowing seasons and consequent delayed crops make the uprooting within the due date a hardship. Favourable showers in the hot weather give a good second flush and the ryots find it hard to eradicate a crop full of bolls. Exempted areas in the adjoining districts and zamindari tracts add to the troubles of enforcement. Even so, after trying a delayed period for uprooting and finding that similar concessions nullified the intentions of the Act, it is now definitely enforced fixing the date of removal to the 31st August. A close collaboration between the Revenue and Agricultural officers has been made possible in the enforcement of this Act. Preceded as such enforcement was by a good deal of propaganda, and realizing as the cultivators do the beneficient effect of the Act, the necessary atmosphere has been created to enforce the Act against defaulters without scaring the cultivators and raising a premature agitation against the Act. In 1934 nearly 300 prosecutions were made. It is now generally admitted by ryots and firms dealing in Cambodia cotton that its quality has improved since the continuous enforcement of the Act for some years.

Pest Act against the Hairy Caterpillar.

323. The hairy caterpillar pest damages heavily in some years the groundnut and *cumbu* crops. The pest occurs in a severe form in the districts of North Arcot, South Arcot, Trichinopoly and Salem. The only effective control is of a preventive nature. A careful watch must be kept for the emergence of the moths after the first rains of the season and they must be caught by hand and destroyed before they can lay eggs on the crop. This method needs organization and has been demonstrated in many places with success. There are many emergences of moths in a season. To illustrate the simplicity of the preventive measure advocated it may be stated that in one year over an area of 100 acres, 16 lakhs of moths were caught, within one month in eight emergencies. The cost of the catch works to about Re. 1 an acre, and the gain from the produce saved is manyfold. As there was not sufficient co-operation forthcoming from the ryots in adopting even these simple control measures, the Pest Act was enforced in 1929. By the application of this Act the ryots were compelled to adopt these control measures and in the case of those who would not do so the Government had the moths picked and the cost recovered from them. Gradually the cultivators are becoming more and more alive to the necessity for taking prompt action immediately the pest is noticed and it is being effectively checked. The Act continues to be in force although the necessity for the enforcement of the penal provisions have not arisen.

Pest Act against Coconut Caterpillar.

324. An outbreak of a pest on coconut trees caused by a caterpillar known as *Nephantis serinopa* occurred in Mangalore and the neighbourhood in January 1922. It attracted no particular notice until June when it had spread over a considerable area. This caterpillar is a well-known pest and causes a good deal of damage in Ceylon, and when it is introduced into a new district like this it is apt to spread very rapidly and do a considerable amount of damage. The pest has been found to be spreading along lines of communication such as canals, back-waters and roads, and through the infested leaves being carried as covers to tiles, fish and baskets. The only known remedy is to cut off the attacked leaves and burn them, thus destroying all the caterpillars on them. It is obvious that the success of any method of control must depend on the co-operation of the people concerned. If some adopt the remedy and others do not, then no headway can be made, since trees that are freed from insects soon become infected again from those which are untouched. It was found impossible to obtain the necessary degree of co-operation to deal successfully with this pest by mere educative and persuasive methods, despite an organized attempt to do so, and finally in December 1922 at the request of the Collector and many local landlords, the Pest Act was introduced and the responsibility for working it fell on the Revenue authorities, although officers of this department gave as much help as possible. By cutting and burning infected leaves, the pest has been kept fairly well in check but has, by no means, been stamped out. It is possible that it can be controlled by its natural parasites, but the burning destroys these parasites along with the caterpillars. The problem was, therefore, to encourage the parasite alone. This was possible by keeping infected leaves in cages of wire mesh of a size that will let out the smaller sized parasite and entrap the bigger-sized pest. By this method the parasite population was increased. This was supplemented by importations of fresh parasites from Cochin. By these measures the pest has been kept in bounds. This campaign provides an interesting example of the smooth working of a Pest Act whose operations were supplemented by a biological control of the pest made possible through research. The cultivators have now realized the *modus operandi* in this control and with the disbanding of the special staff in 1931 this campaign against the coconut caterpillar has become part of the Agricultural Demonstrators' propaganda.

Pest Act against the Bud-rot of Palmyra.

325. In the districts of Godavari, Kistna and Guntur, a fungus disease, the bud-rot of palmyra, was found to attack the growing bud of the palmyra and of the coconut palm resulting in its rot and the death of the tree. The infection spreads from tree to tree. The remedy is to cut off and burn the tops of dead trees and the diseased leaf stalks from diseased trees. A single tree may not be

valuable but when the infection results in the death of lakhs of trees, the loss is serious. This infection spreads to the more valuable coconut also. Owing to the apathy of the ryots in carrying out this simple operation, the Pest Act had to be enforced. A special staff under a Deputy Collector was in charge of the enforcement of the Act. The public have been educated to realize the importance of these operations and the Act worked smoothly. The special staff was disbanded in 1930. The Agricultural Demonstrators now carry on the necessary propaganda for the control of the disease. The Act is still in force in the districts of Godavari, Kistna and part of Guntur. The disease having appeared in the Palghat taluk, the Act was extended to Malabar in 1933.

Pest Act against the Water Hyacinth.

326. The water hyacinth is a familiar weed that floats in ponds and waterways, gradually clogging and choking them. It has lovely lilac flowers and multiplies rapidly and insiduously. The Pest Act against this bewitching weed is in operation in certain taluks of Guntur, Chingleput, South Arcot, Tanjore and Malabar districts.

Cotton Transport Act.

327. The Pest Acts whose operations have been described above safeguard against pests of vegetable and animal origin. It is not enough to protect produce from pests of this kind only. Its purity must be ensured. In the case of commercial crops conformation to recognized commercial standards is of great importance. The purity of cotton is open to attack at all stages from sowing to spinning. Mixing may take place firstly of seed before sowing, secondly of kapas before ginning, thirdly of lint or waste before pressing and lastly inferior imported cotton may even be passed off in its entirety as a genuine article. The quality and reputation of the trade types have been greatly lowered by these practices in the past. It is to restore the lost reputation that the Cotton Transport Act was put into force in 1925. The Act declares two recognized trade areas as protected, (1) the southern area consisting of the eleven southern districts of Chingleput, South Arcot, Chittoor, North Arcot, Salem, Coimbatore, Trichinopoly, Tanjore, Madura, Ramnad and Tinnevelly, and (2) the northern area consisting of the "Northerns" and "Westerns." The cottons of the southern area were subject to adulteration by the importation of inferior cotton from Mysore and the Deccan and those of the "Northerns" and "Westerns" area from the inferior 'Coconadas' cotton from the Circars and cotton from Bombay, Central Provinces and adjacent territories. The Act lays down that no cotton, *kapas* or seed may be imported into these areas by rail and sea except under a licence issued by the Director of Agriculture. The object of this Act is to maintain and improve the standard of the cotton in the protected areas in every one of which the department has evolved and given out to the ryots improved types. The endeavours of

the department have been nullified by the flood of inferior cotton brought into the area by short-sighted middlemen and merchants intent on immediate profit. The import of cotton seed for cattle food is however permitted. Half the cotton grown in India is consumed in Indian mills. The other half goes to Japan, China and European continent. Trade interests require that the reputation of Indian cottons should be maintained and it is the object of the Act to ensure this.

Cotton Ginning and Pressing Factories Act.

328. The Cotton Ginning and Pressing Factories Act was a necessary corollary to the Cotton Transport Act and was passed in 1925. In 1934 there were 600 ginning factories and 67 pressing factories in the presidency. The main provision of the Act is to mark with identification and number marks the bales pressed for consumption or transport. A register has to be maintained by the factories and a return of their activities has to be submitted in printed forms every week. To ensure the use of proper scales and weights certain select officers have been empowered to exercise checks on these factories with the help of standard weights with which they are provided.

Cotton Control Act.

329. To safeguard the purity of the 'Tinnies' cotton, the Cotton Control Act was passed in 1932. It was enforced in the districts of Tinnevelly, Madura, and Ramnad in 1933. It prohibits the cultivation and mixing of the inferior *pulichai* (*G. neglectum*) cotton with the local cottons. The enforcement of the Act has produced a salutary effect and its operations have been extended till 1938.

Commercial Crops Markets Act.

330. The Madras Commercial Crops Markets Act (Act XX of 1933) was passed with the object of the better regulation of the buying and selling of commercial crops and the securing of fair prices and fair weighments to the growers of these crops. Under the Act Government could notify an area within which no person shall set up any place for the purchase and sale of a commercial crop except under a licence granted by Government and except in accordance with the provisions of the Act. The Tiruppur Municipality has recently been declared as a notified area under the Act to take effect from January 1936. In the light of experience gained in the working of the Act at Tiruppur it is the intention of Government to extend the provisions of this Act ultimately to all areas where Cambodia cotton is grown. The experience thus gained on cotton will help in the extension of the operations of the Act to other commercial crops also. It is not enough to improve the produce and enhance the production. The farmer must reap the fullest benefit from this improvement. A regulated market will ensure an equitable return.

CHAPTER VII.

PUBLICATIONS.

Villagers' Calendar.

331. *A Villagers' Calendar* is published by the department every year in English, and in the four vernaculars Tamil, Telugu, Malayalam, and Kanarese. Each of these is published in the corresponding calendar year. The calendar has about two hundred pages and is full of information of interest to cultivators. In addition to the calendar of the year there are sections dealing with agriculture, veterinary science, co-operation, industries, fisheries and public health. Popular notes on subjects of topical interest conducive to the general well-being of the rural community are also included. This feature helps to keep fresh the interest in the calendar and its usefulness for propaganda is thus assured. The price of this publication is fixed at the low sum of one anna a copy to keep it within the reach of the humblest ryot. In the period 1922–1935 over a million copies of the calendar have been made available to the public.

Leaflets.

332. In addition to this annual publication, leaflets on a wide range of over 150 subjects of practical interest have been printed and distributed free. The number of copies so distributed runs into millions. The range of subjects covers a wide field. The leaflets give hints on the cultivation of such crops as sugarcane, plantains, turmeric, lucerne, coconuts, cashewnuts, tapioca, cotton, coriander, potatoes and *Kolinji*, on the advantages of using *sindhewahi* furnaces, bone crushing mills, monsoon ploughs and bund-formers, on the preservation of manure from prickly-pear, and poudrette from night soil, on the advantages of clean cultivation and on general subjects like the raising of trees on *porambokes*, of gardens in schools and on the pest acts conducive to the welfare of the agricultural community. They embrace subjects like the preparation of silage from green fodder and fodder out of prickly-pear. Information on suitable rations for milch cows, the premium scheme for breeding bulls and on aspects of poultry keeping like natural incubation, housing, brooding and rearing of chicks are given in popular language. These leaflets throw light on the life history and control of pests and diseases, such as the army worm of paddy, rice bug, rice hispa, rice hopper, the blue beetle of paddy, hairy caterpillars, stem bleeding in coconuts, *mahali* on arecanuts, mildew on grapes, bud-rot on palmyras, smut on cholam, and mosaic and red-rot on

sugarcane. A full list of these leaflets available for free distribution can be had from the offices of the Deputy Directors of the various circles.

Bulletins.

333. In addition to these small leaflets, bulletins of a larger type are available, priced at a few annas each according to their size. These bulletins cover a wide range of subjects including agricultural proverbs, crop pest calendars, soil surveys, list of injurious insects and information on such crops as *cholam*, coriander, groundnut, fodders, mangoes, pepper, plantains, and sugarcane. These publications are on special topics and are necessarily of restricted value as channels of general information on the activities of the department.

Agricultural Digest and Press Jottings.

334. With a view to educate the public and appraise them of the day-to-day work of the department a monthly digest of the salient features of the activities of the department was begun to be issued from 1922. This was continued every month for seven years till 1929 when it was changed to a quarterly. In 1932 this was discontinued as a measure of retrenchment. Realizing the fact that 53,500 copies of leading newspapers are being circulated daily throughout the presidency, short press notes are being written up as occasions arise and appear in the press periodically as agricultural jottings. This system which is at present in vogue offers the cheapest and the best method of publicity.

Scientific Publications.

335. Apart from this publicity useful in the immediately applicable field of practical agriculture, there is an equally important though less widely known aspect of the department's activity in the field of scientific publications. The Agricultural Research Institute at Coimbatore and the Agricultural Research Stations in the presidency are centres of intense activity in the field of agricultural research. Research is a search for truth and when such truth and aspects of work leading to such truth are getting known and being discovered they afford opportunities for many scientific publications that illumine the subject under study. Intense agricultural research is in progress throughout the world. The accumulation of literature and accession of knowledge are rapid. Experiences vary from country to country and the contributions that the Madras Department of Agriculture is making towards agricultural science is of no mean order. The publications of the officers of the department appear in the following journals :—" Agriculture and Livestock in India," " The Indian Journal of Agricultural Science," " The Indian Journal of Veterinary Science and Animal Husbandry," " The Proceedings of the Indian Academy of Sciences," " The Journal of the Indian Botanical Society," " Current Science," the

"Madras Agricultural Journal," and many such agricultural and other scientific periodicals. Apart from adding to knowledge, their contribution to the general prestige of Madras in the scientific world is substantial.

The Madras Agricultural Journal.

336. Though not an official organ of the Madras Department of Agriculture, the *Madras Agricultural Journal* published at Coimbatore deserves a special mention. This journal is published every month and is the official organ of the Madras Agricultural Students' Union. This union is of a group of old boys and others connected with the department and those interested in the welfare of the agriculturist. Articles of practical, popular and scientific interest appear in this journal which is widely circulated. The department finds in this journal a handy and efficient outlet for the publication of the results of its activities in the field of agricultural research and demonstration.

CHAPTER VIII.

COLLABORATIVE ACTIVITIES.

Collaboration.

337. It is often said that many departments of Government tend to work in water tight compartments. Agriculture either as a science or as an industry can never admit of isolation. The extent to which the Agricultural Department collaborated with other sister departments and organizations to mutual advantage is outlined in the following paragraphs.

Agriculture and Co-operation.

338. The value of co-operation and of the Co-operative Department needs no stressing. The utility of the co-operative agency for agricultural advancement was realized and the closest touch maintained with it. Many Agricultural Improvement, and Loan and Sale Societies are in active operation throughout the presidency. They help in the sale of seed, manure, and implements, and in maintaining breeding bulls. Agricultural demonstrators attend the meetings of these Co-operative Societies to disseminate agricultural knowledge. Some societies maintain warehouses for stocking produce with a view to favourable sale later on. Loans are given by the societies towards the cultivation expenses of needy members. A pointed instance in the successful operation of co-operative endeavour is the Tiruppur Co-operative Trading Society through whose instrumentality there is now a wide area under superior Cambodia cotton. The Lalgudi Sivagnanam Co-operative Agricultural Society in the Trichinopoly district has gone to the extent of owning a farm of its own in which it multiplies its own seed and demonstrates agricultural improvements. It will be seen that the Agricultural Department is working as closely as possible with its sister department and that its work in many cases paves the way for the establishment of co-operative societies. There is need and scope for still closer co-operation between the two departments with reference to non-credit work, and it would appear desirable that this work should be entrusted to officers who have had both an agricultural and co-operative training. With this end, in view, the subject of co-operation has been introduced into the degree course at the College.

Agriculture and Irrigation.

339. The relations between the Agricultural and Industries and Irrigation Departments are very close as they are intimately concerned with the problems of irrigation. The well-known pumping

and boring operations of the Industries Department were once part of the activities of the Agricultural Department. Duty of water experiments have been started at different agricultural stations with the co-operation of the Irrigation Department. Irrigation experiments in connexion with the Lower Bhavani Project and the agricultural aspects of the Tungabhadra Project form the subjects of close contact between the departments. The Director of Agriculture is a member of the Irrigation Development Board.

Agriculture and Public Health.

340. The health of the agriculturist is of vital importance to the country. A close co-operation between the departments of Agriculture and Public Health is therefore of paramount importance. An important instance of this co-operation is the work on the nutritive value of food grains and the estimation of the iodine content of South Indian soils and waters which has been carried out in collaboration with Lieut.-Col. McCarrisson engaged in the investigation of the deficiency diseases at Coonoor. Apart from this, samples of pure milk and butter were analysed in connexion with a Pure Food Act. The propaganda in favour of manure pits and the systematic covering of such pits round villages is also a measure conducive to public health. Advice is being given in the cropping of municipal sewage farms. The manufacture of compost and poudrette with rubbish and night soil was continued to be demonstrated. This was done in the Municipalities of Anantapur, Bellary, Guntur, Calicut and Mangalore. At Bellary 178 tons of this manure were prepared in 1934 and sold at a handsome profit. The activated sludge method of preparing manure from sewage and night soil was advocated, and a complete plant has been installed at the Agricultural College, Coimbatore, to serve as a demonstration in such a disposal.

In the scheme of intensified Rural Development work at Tiruvallur initiated under the general control of the Director of Public Health, two agricultural demonstrators assisted in agricultural propaganda and economic survey.

Similarly in the general activities of Rural Reconstruction organized by the Y.M.C.A. and other bodies, the Agricultural Department played its fullest part.

Collaboration with other Departments.

341. One of the most interesting examples of collaboration has been the case of *ganja*, which has been investigated for the Excise Department. The investigation of the problem has shown (1) that the deterioration of *ganja* is due largely, if not entirely, to the methods of manufacture and storage in vogue, (2) that at every stage from cultivation onwards there is need for improvement, and (3) that the Botany and Chemistry of the plant need intensive study. The Excise Department is acting along the lines indicated. For the Jail Department food materials were examined.

For the Fisheries Department analyses of fish, fish meal and oils have been made; and of bran and straw for the Veterinary Department.

Criminal Settlements.

342. There are many habitually criminal tribes in this presidency. One of the ways in which they are sought to be reclaimed is to concentrate them in special agricultural settlements. Such settlements are mostly in the Nellore and Guntur districts and are at Allur, Attur, Aziznagar, Bitragunta, Kavali, Sitanagaram and Stuartpuram. These settlements have their necessary agricultural activities and the officers of the Agricultural Department pay frequent visits and offer the necessary advice. These settlements provide opportunities for co-operative work with the Labour Department.

Collaboration with Manure Firms.

343. During the last few years there has been a very marked increase in the production of artificial fertilizers in western countries and these products have found their way to India, and several have been placed on the market at prices well within the reach of the ryots in this presidency. The wide choice of these manures is apt to confuse the ryots and they naturally turn to the Agricultural Department for advice on the question. In the absence of exact knowledge the Agricultural Department is not in a position to give them a direct answer. In order to try these manures and obtain the necessary information a manurial experiment station has been started at Maruteru in the Godavari district in co-operation with firms dealing with these fertilizers. These firms pay their share of the cost of these trials. The primary object of this station is to answer simple questions such as, which is the best manure to use and how it should be used. Will the same result be obtained for a similar expenditure of money by using indigenous organic manures like oil cakes? These trials are essential to safeguard the farmer " against premature application of the discoveries of science to his practice and especially against the wiles of the commercial exploiter of the enhanced reputation of Agricultural Science."

CHAPTER IX.

CONCLUSION.

344. In the foregoing paragraphs an outline of the general activities and achievements of the Agricultural Department, especially during the last thirteen years has been given. This account covers only the salient features of the work. There are various activities and endeavours still imperfect and waiting for time and experience for fruition. Without a sound system of agriculture there can be no progressive national life. Constitutional reforms will operate soundly and smoothly according to the degree to which they cater to husbandry. The man behind the plough, as the familiar proverb puts it, is more potent than the weilder of the sceptre. There is a large awakening of the national consciousness and a very real alertness has come to stay in the villages and in the villagers. The standard of living of the agriculturist has to be raised and his purchasing power increased. The effects of such an increase get nullified by the constant increase in the population which each census reveals. The whole situation works in a vicious circle. Sound solutions and steady endeavours are called for. In the period ahead, the Agricultural Department has immense responsibilities to discharge. Satisfactory as the account of the work of the department in the past has been, it sinks into insignificance before the collosal work that lies ahead. It is, therefore, the earnest wish of those who are privileged to be at this service, that neither men nor money should be grudged in this great endeavour. The expenditure on the Agricultural Department was about 12 lakhs of rupees in 1921. It is over Rs. 18 lakhs in 1934, showing a 50 per cent increase. This expenditure works out to 10 pies per acre of cultivated area in the presidency. It is interesting to compare this with the United States of America in which the expenditure on agriculture works out to 10 annas per acre of cultivated area. There are, no doubt, fundamental differences between the two countries in natural resources, the density of population, the standard of living and endeavour, and the value of agricultural produce. These factors notwithstanding, the difference between 10 pies and 10 annas indicates in a rough measure the level to which agricultural service has to rise if it is to fulfil its mission of serving the bulk of the population devoted to the production of primary wealth.

GLOSSARY OF BOTANICAL NAMES.

Common name.	*Botanical name.*
A	
Allspice	Pimenta officinalis, Lindl.
Apple	Pyrus malus, L.
Arecanut	Areca catechu, L.
Arika (Tel.)	Paspalum scrobiculatum, L.
Avocado	Persea americana, Mill.
B	
Banana	Musa sapientum, L.
Barley	Hordeum vulgare, L.
Beet root	Beta vulgaris, L.
Bendekai (Tel.)	Hibiscus esculentus, L.
Bengal gram	Cicer arietinum, L.
Betel vine	Piper betle, L.
Brinjal	Solanum melongena, L.
C	
Cabbage	Brassica oleracea, L. var. bullata, DC.
Cambodia cotton	Gossypium hirsutum, L.
Carrot	Daucus carota, L.
Cashewnut	Anacardium occidentale, L.
Castor	Ricinus communis, L.
Cauliflower	Brassica oleracea, L. var. botritis, L.
Cherimoyer	Annona cherimolia, Mill.
Chillies	Capsicum spp.
Cholam (Tam.)	Sorghum vulgare, Pers.
Cinnamon	Cinnamomum zeylanicum, Breyn.
Clove	Eugenia aromatica, Baill.
Cocoa	Theobroma cacao, L.
Coconut	Cocos nucifera, L.
Coriander	Coriandrum sativum, L.
Cotton	Gossypium spp. see Cambodia, *Karunganni, Nadam, Pulichai, and Uppam.*
Crab apple	Pyrus baccata, L.
Cumbu (Tam.)	Pennisetum typhoides, Stapf and Hubbard.
Cumin	Cuminum cyminum, L.
Custard apple	Annona reticulata, L.
D	
Dhaincha	Sesbania aculeata, Pers.
Durian	Durio zibethinus, L.

Common name.	Botanical name.
E	
Elephant grass	Pennisetum purpureum, Schum.
F	
Fig.	Ficus carica, L.
Fox glove	Digitalis purpurea, L.
G	
Ganja (Tam.)	Cannabis sativa, L.
Garlic	Allium sativum, L.
Gingelly	Sesamum orientale, L.
Ginger	Zingiber officinalis, Rosc.
Grape fruit	Citrus paradisi, Macf.
Grape vine	Vitis vinifera, L.
Groundnut	Arachis hypogaea, L.
Guava	Psidium guajava, L.
Guinea grass	Panicum maximum, Jacq.
I	
Ipecacuanha	Psychotria ipecacuanha, Stokes.
Indigo	Indigofera anil, L.
J	
Jack	Artocarpus integer, Merr.
Jalap	Ipomoea purga, Hayne.
Jasmine	Jasminum spp.
Jonna (Tel.)	Same as *cholam*.
K	
Karunganni cotton (Tam.) ..	Gossypium indicum, Lam.
Knol khol (Hindi)	Brassica oleracea, L. var. gongylodes, L.
Kolakkattai grass (Tam.) ..	Cenchrus ciliaris, L.
Kola nut	Cola acuminata, Schot.
Kolinji (Tam.)	Tephrosia purpurea, Pers.
Korai (Tam.) (cultivated) ..	Cyperus corymbosus, Rottb. and C. Pangorei, Rottb.
Korai (Tam.) (weed)	Cyperus bulbosus, Vahl. & C. rotundus, L.
Korali	Setaria pallidifusea, Stapf & Hubbard.
Korra (Tel.)	Setaria italica, Beauv.
Kudiraivali (Tam.)	Echinochloa frumentaceae, Link.
L	
Ladies' fingers	Hibiscus esculantus, L.
Langsat	Lansium domesticum, Jack.
Lemon	Citrus limonia, Osbeck.
Litchi	Litchi chinensis, Sonn.
Loquat	Eriobotrya japonica, Lindl.
Lucerne	Medicago sativa, L.
Lupin	Lupinus spp.

Common name.	*Botanical name.*
M	
Maize	Zea mays, L.
Mango	Mangifera indica, L.
Mangosteen	Garcinia mangostana, L.
N	
Nadam cotton (Tam.) ..	Gossypium obtusifolium, Roxb.
Nanal (Tam.) (wild cane) ..	Saccharum spontaneum, L.
Neem	Azadirachta indica, Juss.
Nutmeg	Myristica fragrans, Hott.
O	
Oats	Avena sativa, L.
Omum (Tam.)	Carum copticum, C.B. Clarke.
Onion	Allium cepa, L.
Orange	Citrus sinensis, Osbeck.
P	
Paddy	Oryza sativa, L.
Palmyra	Borassus flabellifer, L.
Panivaragu (Tam.)	Panicum miliaceum, L.
Papaya	Carica papaya, L.
Peach	Prunus persica, Stokes.
Pear	Pyrus communis, L.
Pepper	Piper nigrum, L.
Persimmon	Diospyros kaki, L.
Pillipesara (Tel.)	Phaseolus trilobus, Ait.
Pineapple	Ananas comosus, Merr.
Plantain	Musa paradisiaca, L.
Plum	Prunus domestica, L.
Pomegranate	Punica granatum, L.
Pomelo	Citrus maxima, Merr.
Potato	Solanum tuberosum, L.
Prickly pear	Opuntia dilleni, Haw.
Pulichai cotton (Tam.) ..	Gossypium neglectum, Tod.
Pungam (Tam.)	Pongamia glabra, Vent.
Q	
Quince	Cydonia oblonga, Mill.
Queensland nut	Macadamia ternifolia, F. Muell.
R	
Ragi (Tam.)	Eleusine coracana, Gaertn.
Rambutan (Burm.)	Nephelium lappaceum, L.
Redgram	Cajanus cajan, L.
Rice	Oryza sativa, L.
Rose	Rosa spp.

Common name.	*Botanical name.*
S	
Sajja (Tel.)	Same as *cumbu.*
Samai (Tam.)	Panicum miliare, Lam.
Sapota	Achras zapota, L.
Senna	Cassia angustifolia, Vahl.
Soya bean (Soy bean) ..	Glycine max, Merr.
Sorghum	Sorghum vulgare, Pers.
Sugarcane	Saccharum officinarum, L.
Sunnhemp	Crotolaria, juncea, L.
Surinam cherry	Eugenia michelli, L.
T	
Tapioca	Manihot utilissima, Pohl.
Tenai (Tam.)	Same as *korra.*
Teosinte	Euchlaena mexicana, Schrad.
Tobacco	Nicotiana tabacum, L.
Tomato	Lycopersicum esculentum, Mill.
Turmeric	Curcuma longa, L.
U	
Uppam cotton (Tam.) ..	Gossypium herbaceum, L.
V	
Varagu (Tam.)	Same as *Arika.*
Variga (Tel.)	Same as *Panivaragu.*
Vasambu (Tam.)	Acorus calamus, L.
Vempali (Tel.)	Tephrosia purpurea, Pers.
W	
Wattle	Acacia spp.
Wheat	Triticum spp.

GLOSSARY OF VERNACULAR AND OTHER EXPRESSIONS.

Brahmini bulls (Sans.)	Un-tethered breeding bulls dedicated to temples.
Ceded Districts	The districts of Cuddapah, Kurnool, Bellary and Anantapur.
Chitrai (Tam.)	A Tamil month from mid-April to mid-May.
Circars	The districts of Ganjam, Vizagapatam, Godavari and Kistna.
Copra (Mal.)	The dried kernel of the coconut.
Firka	A group of villages under the jurisdiction of a Revenue Inspector.
Gorru (Tel.)	A seed drill common in the Ceded districts.
Guntaka (Tel.)	A blade harrow of the Ceded districts.
Jamabandi	An annual gathering in the camp of an important Revenue Officer at which village accounts are checked and the grievances of villagers are heard and redressed.
Kallar (Tam.)	A Tamil backward community of the Southern districts of the Madras Presidency.
Kapas	Picked cotton with seed.
Kar (Tam.)	An early agricultural season of the Tanjore delta (June to September).
Koleroga (Can.)	See 'Mahali.'
Kuruvai (Tam.)	The early season paddy crop of Tanjore (June to September).
Mahali (Mal.)	A fungus disease (*Phytophthora omnivora*) var. *arecae* (Coleman) affecting arecanut.
Maistry (Hindi)	An agricultural master-workman assisting the demonstrator in the demonstration of agricultural improvements.
Mammooty (Tam.)	The common iron spade with a wooden handle used for digging soil.
Manjal (Tam.)	Yellow.
Mhote	An indigenous water lift worked by a pair of bullocks moving on an inclined plane.
M.M.	Abbreviation for 'Madras Measure'—the standard measure of the bazaars—capacity 108 cubic inches.
Modan (Mal.)	The uplands of Malabar unsuited for wet cultivation.
Pacha (Tel.)	Yellow.
Pairu (Tel.)	The agricultural season (October to December).
Poramboke (Tam.)	Waste lands adjoining villages or cultivated lands.
Pothy (Tam.)	A unit of weight for weighing cotton = 250 lb.
Punasa (Tel.)	The agricultural season (June to September).
Putti (Tel.)	A unit of measure—a 'putti' of paddy weighs 2,210 lb.
Samba (Tam.)	The agricultural season August to January.
Takkavi Loans	Loans given by Government to *bona fide* cultivators for agricultural purposes.
Tella (Tel.)	White.
Udu (Tam.)	Refers to a system of paddy cultivation in the Tanjore delta in which a long (seven months) duration and a short (three months) duration variety are grown mixed.
Vellai (Tam.)	White.

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